

# VCE Mid-Year Exam Revision 2011

## Psychology

**Kate Lefel**

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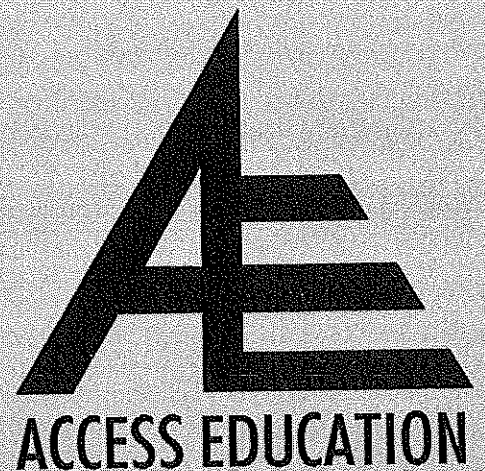
Note: there may not be supplementary material for all lectures.

**Coming in 2011:**  
**Essential English:**

**ACU**  
Sunday 25<sup>th</sup> September

**Monash Clayton**  
Sunday 2<sup>nd</sup> October

**Monash Peninsula**  
Sunday 9<sup>th</sup> October



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## **Access Education Coming Events:**

### **Essential English for VCE Units 3 & 4**

These lectures provide in-depth analysis of the most popular VCAA List One texts for 2011, along with specialised exploration of each of the four Contexts and advice on successfully writing in context. The skills of language analysis will also be highlighted in readiness for this year's English exam.

Australian Catholic University, Melbourne (City) Campus  
Sunday 25 September

Monash University, Clayton Campus  
Sunday 2 October

Monash University, Peninsula Campus  
Sunday 9 October

**Price: \$25 per person per lecture or any 3 lectures for \$60**

### **End of Year Exam Revision Lectures VCE Units 3 & 4**

If you found this lecture valuable for your Unit 3 revision and exam preparation look out for details of our End-of-Year Revision Lectures in September & October.

Access Education is the largest provider of VCE exam revision programs in Victoria and gives you the greatest choice of subjects, at convenient venues to save you precious time - and all at affordable prices! Lectures will be held at:

- **Berwick** – Monash University
- **Bundoora** – LaTrobe University
- **Clayton** – Monash University
- **Melbourne** – ACU City Campus
- **Peninsula** – Monash University
- **Ballarat** – University of Ballarat
- **Bendigo** – LaTrobe University
- **Gippsland** – Monash University
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- **Wodonga** – LaTrobe University

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- Please note –The information regarding curriculum and assessment of VCE Psychology is from the VCE Psychology Study Design (VCAA, 2009).

### **VCE Psychology Units 3 & 4**

The award of **satisfactory completion for a unit** is based on a decision that the student has demonstrated achievement of the set of outcomes specified for the unit. This decision will be based on the teacher's assessment of the student's overall performance on assessment tasks designated for the unit.

The **level of achievement** is determined by school-assessed coursework, a mid-year examination and an end-of-year examination. The Victorian Curriculum and Assessment Authority will report the student's level of performance on each assessment component as a grade from A+ to E or UG (ungraded). To receive a study score, students must achieve two or more graded assessments and receive S for both Units 3 and 4. The study score is reported on a scale of 0–50. It is a measure of how well the student performed in relation to all others who took the study.

(VCAA, 2004)

#### **Contribution to assessment:**

- Unit 3 school-assessed coursework: 17 per cent
- Unit 4 school-assessed coursework: 17 per cent
- Mid-year examination: 33 per cent
- End-of-year examination: 33 per cent

**Each Area of Study is assessed by a key Outcome. To prepare for each assessment outcome students need to draw on the *key knowledge* and *key skills*, outlined in the VCAA study design.**

#### ***School-assessed coursework (SACs)***

Teachers provide the Victorian Curriculum and Assessment Authority a score representing an assessment of the student's level of achievement. The score is based on the teacher's rating of performance of each student on a number of tasks. The assessment tasks are a part of the regular teaching and learning program and completed mainly in class and within a limited timeframe.

### **VCE PSYCHOLOGY UNIT 3**

**Unit 3, The Conscious Self includes the two Areas of Study: Mind, Brain and Body and Memory.**

Each Area of Study is assessed by a key Outcome. To prepare for each assessment outcome students need to draw on the *key knowledge* and *key skills*, outlined in the VCAA study design.

#### **AREA OF STUDY 1**

##### **Mind, Brain and Body**

This area of study focuses on the role of the functioning brain and nervous system in relation to awareness of self, the environment and behaviour.

##### **Outcome 1**

On completion of this unit the student should be able to explain the relationship between the brain, states of consciousness including sleep, and behaviour, and describe the contribution of selected studies and brain research methods to the investigation of brain function.

#### **AREA OF STUDY 2**

##### **Memory**

Students investigate the retention of experiences and learning as memory and the factors that affect retention and recall of information.

##### **Outcome 2**

On completion of this unit the student should be able to compare theories that explain the neural basis of memory and factors that affect its retention, and evaluate the effectiveness of techniques for improving and manipulating memory.

### ***Unit 3 School-assessed coursework (SACs)***

School-assessed Coursework for the outcomes in Unit 3 will contribute 17 per cent to the student's study score for Psychology. There are two pairs of assessment tasks (four assessment tasks in total) that may be used to assess Unit 3. Pair A may be selected for **either** Outcome 1 **or** Outcome 2. Pair B must be utilised for the outcome not covered by Pair A.

#### **PAIR A**

Report of a research investigation conducted by the student (30 marks)

#### **AND**

one other task selected from:

- data analysis
- media response
- test

(20 marks)

#### **PAIR B**

Two tasks selected from:

- evaluation of research
- data analysis
- essay
- media response
- annotated folio of practical activities
- oral presentation using two or more data types
- test
- visual presentation

(25 marks each)

### ***Mid-year examination***

#### **Description**

All outcomes in Unit 3 will be examined.

There will be 15 minutes reading time and 1 hour 30 minutes writing time. VCAA examination rules will apply. Details of these rules are published annually in the *VCE and VCAL Administrative Handbook*.

The examination will be marked by a panel appointed by the VCAA.

The examination will contribute 33 per cent to the Study Score.

#### **Content**

All outcomes of Unit 3 will be assessed in the examination. All key knowledge and skills are examinable.

Each examination will assess a representative sample of the key knowledge which underpins the outcomes of each unit. The assessment of the key skills which underpin all units of the *VCE Psychology Study Design 2011–2014* will be integrated within questions assessing the key knowledge.

The weightings of questions in the examination will reflect the weightings in the outcomes in the study design. Area of Study 1 Mind, Brain and Body will be worth approximately 50% of the available marks and Area of Study 2 Memory will also be worth approximately 50% of the available marks.

#### **Format**

Each examination will be presented in a question and answer book and will consist of three compulsory sections:

Section A, Section B and Section C.

Section A will consist of 45 multiple-choice questions worth 1 mark each.

Section B will consist of short answer questions. Students will be required to provide answers to Section B within the spaces allocated in the examination paper. The number of lines provided after each question, together with the number of marks allocated, will indicate the appropriate length of the response. Section B will be worth 30–35 marks.

Section C will consist of one question. This question may require students to comment on experimental design or write up the results of a case study/experiment or to write an extended response in response to a question or case study or experiment. This question will be worth 10–15 marks.

Questions in the examination will **not** be organised according to areas of study.

In all of Sections A, B and C, questions may be asked which cover individual areas of study and/or which cover more than one area of study as well as research methodologies and ethical principles.

## GENERAL REVISION HINTS:

### HOW TO STUDY

Firstly there is no right or wrong way to study. Try a number of different activities and techniques and find what suits you best.

Keep up to date – we all get behind with homework at times, but the best way to prepare for exams is to avoid cramming and leaving it until the last minute – coming today is a great start!

Make sure you have detailed notes for every “dot-point” of the study design. Don’t forget the general Key Skills Unit 1 – 4 and the Research methodologies and ethical principles for each unit – as these are also examinable.

Once you have a complete set of notes use what works for you to revise them. Re-reading, re-writing or recording and listening to the notes you have already written may help. Re-creating notes, such as making posters, flow-charts or study cards – especially for some small but more difficult concepts will also enhance your understanding.

Then consider some of the suggestions below closer to the exam time.

Before starting revision ask yourself the following:

1. Do you have...

- ☐ A copy of the VCAA Study Design for VCE Unit 3 Psychology?
- ☐ Past VCAA examinations? – NOTE these are for the OLD study design but may give an indication of what multiple choice and short answer questions have looked like in the past and some of the content is similar. Check the old Unit 4 exams for some memory questions.
- ☐ Copies of the VCAA assessor reports from the last 3 years? – NOTE – as above

[www.vcaa.vic.edu.au](http://www.vcaa.vic.edu.au) will provide you with access to all of these important documents and keep checking the site for more details as the year progresses.

- ☐ Study/revision guides, flash cards etc? NB **Be careful as some of these were published before the study design was finalised even if they say for the new study design– also check if they have a Section C as this is the most important change in the exam.**

2. Use the VCE Psychology Study Design to organise your revision notes. Make sure that you have detailed notes for each of the “dot points” for both Key Knowledge *and* Key Skills.

3. “The Best Students Study What They Don’t Know”. What are your strengths and weaknesses? Use your revision of each of the dot points to reflect on areas in need of improvement. Begin your revision with one of your weaker areas – resist the temptation to study what you are already comfortable with and attack the areas that you might ordinarily avoid.

4. Complete practice exams and analyse your results.

Plan the use of your practice examinations – maybe study Visual Perception and then complete just that section of an exam.

- ☐ Spend a quick 20 minutes doing one set of multiple choice questions.
- ☐ Complete a set of Short Answer Questions ‘open book’ – trying to come up with a perfect response.
- ☐ Use this time to establish your strengths and weaknesses – add up all of the Multiple Choice and Short Answer responses for each Area of Study to see which was the lowest.
- ☐ Learn from other people’s mistakes! Carefully analyse the Assessment Report to see what examiners are looking for and also where students have lost marks in the years before.
- ☐ Finally make sure that you do practice some papers in conditions as close as possible to the real examination – ie. At the same time of day – not at 3am the night before.



## **Units 1–4: Key skills**

These skills include the ability to:

### **Investigate and inquire scientifically**

- formulate research questions and construct testable hypotheses
- design and conduct investigations using experimental and non-experimental methods such as observation studies, case studies and correlation studies
- collect, record and summarise both quantitative and qualitative data
- analyse and interpret data, and draw conclusions consistent with the research question
- evaluate the validity and reliability of research investigations including potential confounding variables and sources of error and bias
- work independently and collaboratively as appropriate and within identified research constraints
- adhere to current occupational health and safety codes and ethical guidelines for conducting psychological investigations.

### **Apply psychological understandings**

- use research literature to demonstrate how psychological concepts and theories have developed over time
- process and interpret information, and make connections between psychological concepts and theories
- apply understandings to both familiar and new contexts
- evaluate the validity and reliability of psychology-related information and opinions presented in the public domain
- analyse issues relating to and implications of scientific and technological developments relevant to psychology.

### **Communicate psychological information and understandings**

- communicate psychological information, ideas and research findings accurately and effectively
- use communication methods suitable for different audiences and purposes
- use scientific language, conventions and referencing of information sources appropriate to the medium of communication.

## **UNIT 3 The Conscious Self**

The **research methodologies** and **ethical principles** considered in this unit are:

- experimental research: construction of research hypotheses; identification of operational independent and dependent variables; identification of extraneous and potential confounding variables including individual participant differences, order effects, experimenter effect, placebo effects; ways of minimising confounding and extraneous variables including type of experiment, counterbalancing, single and double blind procedures, placebos; evaluation of different types of experimental research designs including independent-groups, matched-participants, repeated-measures; reporting conventions
- sampling procedures in selection and allocation of participants: random sampling; stratified sampling; random-stratified sampling; random allocation of participants to groups; control and experimental groups
- techniques of qualitative and quantitative data collection: case studies; observational studies; selfreports; questionnaires; interviews; brain imaging and recording technologies
- statistics: measures of central tendency including mean, median and mode; interpretation of p-values and conclusions; reliability including internal consistency; validity including construct and external; evaluation of research in terms of generalising the findings to the population
- ethical principles and professional conduct: the role of the experimenter; protection and security of participants' rights; confidentiality; voluntary participation; withdrawal rights; informed consent procedures; use of deception in research; debriefing; use of animals in research; role of ethics committees.

## AREA OF STUDY 1

### The Conscious Self

- consciousness as a psychological construct informed by the work of René Descartes and William James

**Consciousness** is the awareness of objects and events in the external world and the subject's own existence and activities.

Consciousness is **PERSONAL** (it is subjective – your own interpretation) **SELECTIVE** (you can pay attention to some sensations etc and ignore others) it is **CONTINUOUS** (it never stops altogether – flows from one continuous thought process to another) and it is **CHANGING** (never stops shifting focus from one thought/feeling etc to another).

### René Descartes

*cogito ergo sum* "I think, therefore I am,"

According to Descartes it is our ability to think and reason that distinguishes us from machines and animals. Descartes then divided the universe into material things, *res extensa*, that exist in space, and *res cogitas*, consciousness, a mind that thinks but has no material extension. The resulting duality of mind and body came to be known as dualism. He claims that the mind and body are two distinct entities and that the mind is immaterial and is not made up of matter. Descartes argued that the mind is a non-physical substance distinct from the body. He also did not believe in the existence of unconscious mental states, a view certainly not widely held today. Descartes defined "thinking" very broadly to include virtually every kind of mental state and urged that consciousness is essential to thought. Our mental states are, according to Descartes, infallibly transparent to introspection.

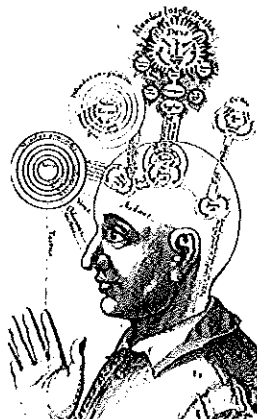


### William James

James finds consciousness to be a stream rather than a succession of "ideas." Its waters blend, and our individual consciousness is "steeped and dyed" in the waters of consciousness or thought that surround it. Our psychic life has rhythm: it is a series of transitions and resting-places, of "flights and perchings". We rest when we remember the name we have been searching for; and we are off again when we hear a noise that might be the baby waking from her nap.

Our capacity for attention to one thing rather than another is for James the sign of an "active element in all consciousness...a spiritual something...which seems to go out to meet these qualities and contents, whilst they seem to come in to be received by it".

Representation of consciousness from the 17th century.



- concepts of normal waking consciousness and altered states of consciousness, including **daydreaming, meditative and alcohol-induced**, in terms of levels of awareness, content limitations, controlled and automatic processes, perceptual and cognitive distortions, emotional awareness, self-control and time orientation

*States of consciousness* are our **level** of awareness of our **internal state** and **external events**

- our state of consciousness can be likened to a continuum or a scale from very high awareness of our thoughts to very little or no awareness.

We shift continuously along the continuum

An example of a continuum of awareness:

#### TOTAL AWARENESS

- Heightened awareness
- Focussed attention
- Ordinary wakefulness
- Divided attention
- Daydreaming
- Sleep
- Anaesthetised
- Coma – unconscious

#### COMPLETE LACK OF AWARENESS

#### Characteristics of Normal Waking Consciousness

**Level of awareness** – shifts between awake and alert on the continuum - high levels of awareness such as focussed attention as well as divided attention are possible

**Content Limitations** – enables us to control the contents of our thoughts, feelings and perceptions to a degree. Unpleasant thoughts, memories etc can be avoided by focussing attention on other tasks or sensations. The content of our thoughts are more restrictive than when in as ASC.

**Attention** – can be focussed on one task, feeling, sensation, or thought process. It can be controlled and selective. It can also be divided to enable more than one task simultaneously.

Awareness – can easily shift from internal state/feelings etc to awareness of external stimuli.

#### High Level and Lower Level Awareness

Some processes require a higher level of awareness than others.

- **controlled processes** – require conscious mental effort and high levels of focussed attention
- **automatic processes** – require very little awareness and conscious effort, and are often involved in divided attention when more than one task is undertaken at the same time stationary, alone, waiting to fall asleep or in the midst of boring or routine activities.

**Perceptual and cognitive distortions** – unlikely to occur in NWC

**Emotional awareness, self control and time orientation** – These are usually normally functioning in NWC. We can monitor and to some extent control our emotions, have good self control and an acute sense of time.

#### Altered States of Consciousness

Determining if an ASC markedly different from the characteristics of normal waking consciousness.

They can be...

- Naturally occurring ASCs such as Daydreaming, Sleep

And Dreaming

- Purposely induced ASCs such as Meditation and Alcohol induced



Psychological changes vary from person to person. They may include:

- **Shift in level of awareness** – can be heightened or become less aware such as increased awareness of breathing in meditation
- **Content Limitations** – less control over the content of your thoughts – such as nightmares when asleep.
- **Controlled and automatic processes** – may experience difficulty with both tasks that require selective attention and may not be able to use divided attention in situations which usually require little thought.
- **Perceptual distortions**

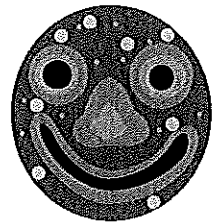
- Change in the way SENSATIONS are experienced –

More receptive to external stimuli or dulls them until no sensations are experienced (eg. Meditation).

- PERCEPTIONS can be distorted and may include a loss of sense of identity, feel that they are someone else, feel that they are 'outside' themselves', lose touch with reality

- **Cognitive distortions**

- Thinking is illogical, lacking sequence, difficulty with problem solving Eg. Dreams
- Information processing is impaired.
- Memory of events occurring during an ASC may be impaired, inaccurate or absent.

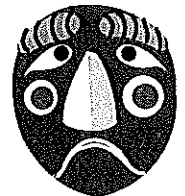


- **Emotional awareness**

Change in the way emotion is experienced and with less control– unpredictable/extremes. May become more aggressive or angry or extreme happiness or sadness. Emotions may be inappropriate.

- **Self control**

- less control over movements and decision making
- less control over the expression of emotion – such as affection, aggression
- more susceptible to suggestion
- may have more self control



- **Time orientation**

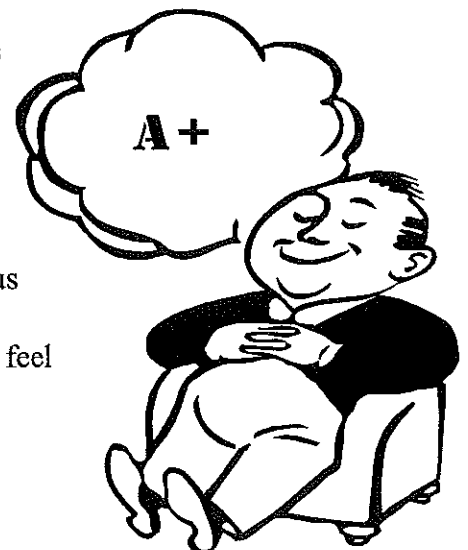
- time seems to pass at a different rate (either more slowly or more quickly) during an ASC) Such as during sleep or daydreaming.

### Daydreaming as an ASC

Daydreaming is a shift of attention to internal thoughts, feelings, imaginations and perceptions.

It is an ASC because:

- **Shift in level of awareness** decreased in level of awareness of what is occurring around us
- **Content Limitations** fewer content limitations/restrictions – imagination/fantasy thoughts
- **Controlled and automatic processes** cannot use selective attention and divided attention is impaired
- **Perceptual distortions** may become less aware of noises etc around us
- **Cognitive distortions** impairs new memories as attention is diverted
- **Emotional awareness** usually positive, and make us happier but may feel sadder if already upset or flatten our emotional response.
- **Self control** not really monitoring your behaviour when daydreaming
- **Time orientation** often appears to pass more slowly or very quickly



**Meditation as an ASC** is an induced state of consciousness that focuses on breathing or a single word or image to heighten awareness and increase thought control

- **Shift in level of awareness** heightens awareness of thoughts or breathing but lowers awareness of surroundings
- **Content Limitations** increases control over thoughts which can then block unwanted thoughts in order to become calm and relaxed
- **Controlled and automatic processes** the process of focussing on breathing etc is a controlled process – but other processes are unable to be performed
- **Perceptual distortions** may be used to control the perception of pain – usually lower perceptions and awareness
- **Cognitive distortions** used to calm and relax, meditation can increase thought control
- **Emotional awareness** again aims to relax and increase thought control
- **Self control** aims to increase self control
- **Time orientation** may seem to pass quickly or be stationary



**Alcohol induced ASC** as alcohol is a depressant it slows the nervous system

- **Shift in level of awareness** become less aware of surroundings as the nervous system slows down
- **Content Limitations** have less control over the contents of our thoughts. Therefore our thoughts may broaden, may be more creative and yet have less control also over logic etc.
- **Controlled and automatic processes** as the nervous system slows, we lose the ability to effectively use selective attention and tasks which can usually be accomplished with divided attention require more thought and may be impossible.
- **Perceptual distortions** may dull senses and pain. Blurred vision and distorted hearing as the nervous system is slow
- **Cognitive distortions** may affect speech, difficulty creating and accessing memories, problem solving and decision making
- **Emotional awareness** may heighten or lessen emotional awareness. May become happy, sad, aggressive or experience as increase in confidence.
- **Self control** as decision making and thought processes are affected so is self control. May lose inhibitions and be more open to suggestions.
- **Time orientation** estimation of time is often poor when in an alcohol ASC



• **sleep as an altered state of consciousness:** purpose, characteristics and patterns of the stages of sleep including rapid eye movement (REM) and the non-rapid eye movement (NREM) stages of sleep

Sleep is an ASC because it differs markedly from normal waking consciousness. Our awareness of stimuli is decreased, there may be a disturbed sense of time, we do not have the same control over cognitive processes and through dreams we have perceptual experiences without stimuli.

### **Purpose of sleep**

A number of different theories exist explaining the purpose of sleep. New technologies have enabled further investigation of some of these theories.

**Repair and Restoration:** This theory proposes that the purpose of sleep is to enable the mind and body to rest and restore to maintain a healthy level of functioning. This theory suggests that NREM sleep is important for restoring physiological functions, while REM sleep is essential in restoring mental functions. Support for this theory is provided by research that shows periods of REM sleep increase following periods of sleep deprivation and strenuous physical activity. During sleep, the body also increases its rate of cell division and protein synthesis, further suggesting that repair and restoration occurs during sleeping periods.

**Evolutionary /Adaptive Theory:** This theory suggests that the purpose of sleep is a period of inactivity that has evolved as a means of conserving energy. According to this theory, all species have adapted to sleep during periods of time when wakefulness would be the most hazardous.

Support for this theory comes from comparative research of different animal species. Animals that have few natural predators, such as bears and lions, often sleep between 12 to 15 hours each day. On the other hand, animals that have many natural predators have only short periods of sleep, usually getting no more than 4 or 5 hours of sleep each day.

**Information Consolidation Theory of Sleep:** This theory of sleep suggests that people sleep in order to process and consolidate information that has been acquired during the day. In addition to processing information from the day prior, this theory also argues that sleep allows the brain to prepare for the day to come. Some research also suggests that sleep helps cement the things we have learned during the day into long-term memory. Support for this idea stems from a number of sleep deprivation studies demonstrating that a lack of sleep has a serious impact on the ability to recall and remember information.

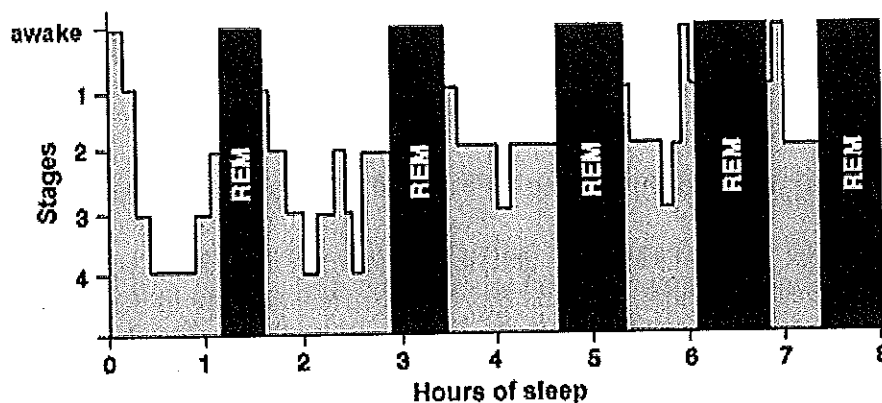
### Characteristics and stages of sleep

(Great resource: <http://science.education.nih.gov/supplements/nih3/sleep/guide/info-sleep.htm>)

Firstly, sleep can be divided into either REM or NREM sleep. An electrooculogram will measure periods of rapid eye movements (REM) during the sleep cycle. We classify these periods of sleep as REM sleep and those periods when there is not rapid eye movements as NREM (non-rapid eye movement). The NREM sleep is then divided into four distinct stages. Physiological measurements recorded during sleep, show distinct changes in brain activity, eye movement, muscular activity, heart rate, breathing activity, body temperature and GSR as we experience each of the stages of sleep.

Sleep is a cycle. During sleep, people experience repeated cycles of NREM and REM sleep, beginning with an NREM phase. This cycle lasts approximately 90 to 110 minutes and is repeated four to six times per night. As the night progresses, however, the amount of deep NREM sleep decreases and the amount of REM sleep increases.

The chart below is called a **hypnogram**. It is a summary of the data collected and indicates the periods of REM and NMREM sleep. We can make several observations about the hypnogram. First, the periods of NREM and REM sleep alternate during the night. Second, the deepest stages of NREM sleep occur in the first part of the night. Third, the episodes of REM sleep are longer as the night progresses. This hypnogram also indicates two periods during the night when the individual awakened (at about six and seven hours into the night).



**Figure 4.** A typical hypnogram from a young, healthy adult. Light-gray areas represent non-rapid eye movement (NREM) sleep.

REM SLEEP	NREM SLEEP
<ul style="list-style-type: none"> <li>• Rapid Eye Movement detected on EOG</li> <li>• Called paradoxical sleep – as internally body is very active, yet externally it appears paralysed</li> <li>• Irregular Beta waves</li> <li>• More active internal functioning than NREM</li> <li>• Heart rate increases</li> <li>• Blood Pressure increases</li> <li>• Breathing rate increases and is irregular</li> <li>• Cataplexy – appears paralysed as muscles are very relaxed</li> <li>• Most dreaming occurs in REM</li> <li>• Occurs more frequently and for longer periods as the night progresses</li> </ul>	<ul style="list-style-type: none"> <li>• There are 4 stages of NREM sleep each with its own EEG, EOG and EMG patterns</li> <li>• Generally few eye movements recorded</li> </ul> <p>Stage 1:</p> <ul style="list-style-type: none"> <li>• EEG shows changes from alpha waves (when relaxed and falling asleep) to theta waves. Body temperature, heart rate, breathing rate and muscle tension begin to decrease. Lasts 5-10 minutes</li> </ul> <p>Stage 2:</p> <ul style="list-style-type: none"> <li>• EEG shows less brain activity, breathing becomes regular, heart rate and temperature continue to fall. Lasts 20 about minutes. Brain will still respond to external stimuli (K-complex) and the presence of sleep spindles, indicate a true sleep state.</li> </ul> <p>Stage 3:</p> <ul style="list-style-type: none"> <li>• EEG shows less brain activity again (mixture of theta and delta waves). Heart rate and temperature continue to fall. Lasts about 40 minutes.</li> </ul> <p>Stage 4:</p> <ul style="list-style-type: none"> <li>• EEG shows Delta waves – a very deep level of sleep.</li> </ul>

- methods used to study the level of alertness in normal waking consciousness and the stages of sleep:
  - measurement of physiological responses including electroencephalograph (EEG), electrooculargraph (EOG), heart rate, body temperature and galvanic skin response (GSR)
  - the use of sleep laboratories, video monitoring and self reports

### Measuring physiological responses, which indicate a change in states of consciousness.

**EEG** an electroencephalograph (break down the word... electro (ie measures electricity) encephalon (refers to the brain) graph (it looks like a graph!). Measures the amplitude and frequency of brain wave patterns.

**Heart Rate** significant changes in heart rate (increase or decrease) can be an indication of a change in the level of awareness of a person.

**Body Temperature** changes during some ASCs – such as dropping during sleep

**GSR** galvanic skin response measures the conductivity of the skin or the resistance of the skin to electrical current (it does not measure sweat as such!). The GSR can indicate a change in emotional state and arousal, often associated with an ASC.

### Measuring Sleep

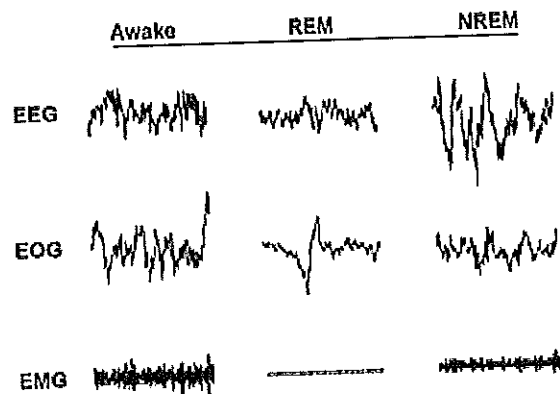
**Sleep laboratories** – contain controlled environments to study sleep. They use a polygraph to measure a number of different biological responses.

**EEG** – electroencephalograph measure different types of electrical activity in the brain associated with different stages and types of sleep. It detects measures, amplifies and records electrical activity in the brain.

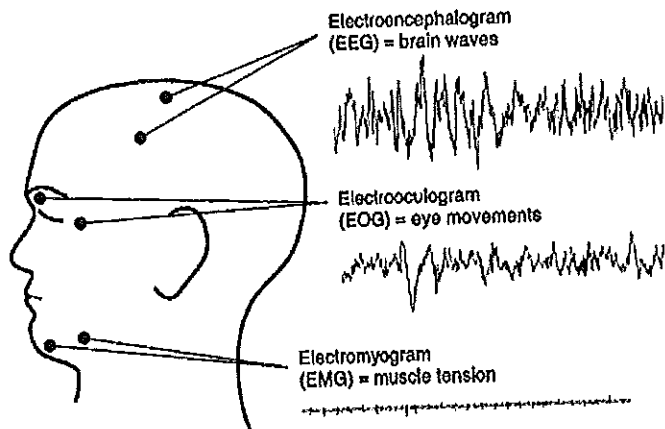
**EOG** – electro-oculargram detects, measures, amplifies and records electrical activity in eye muscles controlling eye movements associated with different types and stages of sleep (such as distinguishing REM and NMREM sleep)

**EMG** – electromyograph detects, measures, amplifies and records electrical activity in the muscles, to show changes in muscle tension, activity and tone associated with various stages and types of sleep.



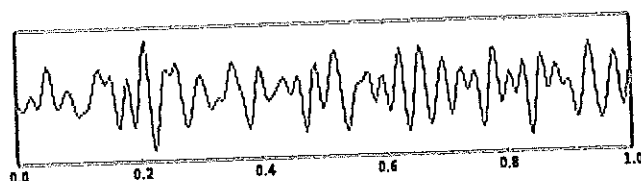


Characteristic EEG, EOG, and EMG patterns for wakefulness, REM sleep, and NREM sleep. Each of the nine patterns was made over a period of about three seconds.

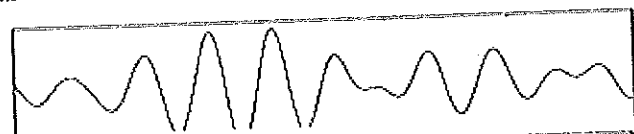


## Characteristics and patterns of the stages of sleep on EEG recordings.

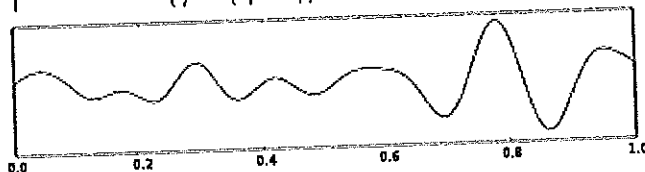
*Beta waves* – high frequency low amplitude  
(**Busy Beta waves**- awake and alert)



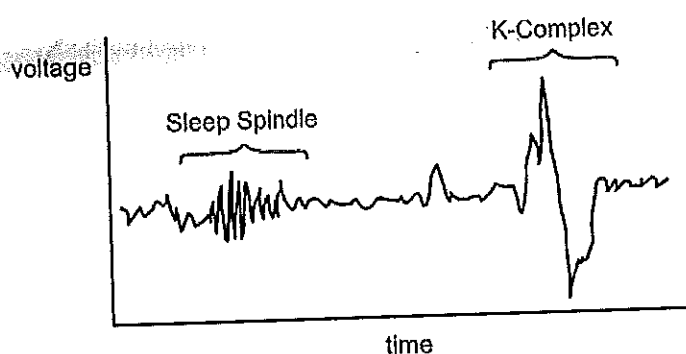
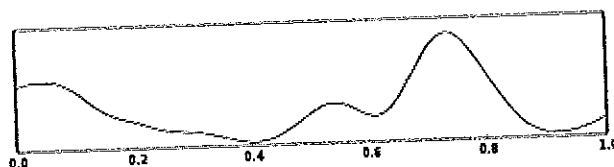
*Alpha waves* – medium to high frequency medium to low amplitude (**Almost asleep**- resting)



*Theta waves* – low frequency and mixed amplitude waves (**They're really asleep** – indicates sleep)



*Delta waves* – low frequency high amplitude (**deep sleep** – also known as slow wave sleep).



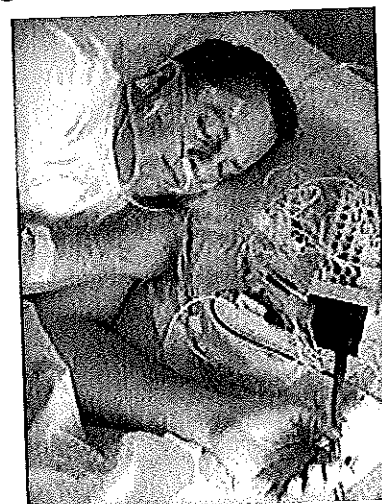
**K-complex** (burst of high amplitude) in response to an internal or external stimulus such as a phone ringing..

**Sleep spindles** (burst of high frequency) associated with being truly asleep.

**BOTH Occur During Stage 2 NREM sleep.**

## Sleep laboratories, video monitoring and self reports

Sleep laboratories enable the collection of both qualitative and quantitative data in relation to sleep. They provide a controlled environment where the participant is connected to the various measurement devices – such as EEG, EOG, EMG, thermometer, heart rate monitor etc. It also provides an opportunity video monitoring and recording of sleep for observation of behaviours, such as snoring, sleep talking and movements. Self reports can collect qualitative data and are often used before participants or patients enter the sleep laboratory. It enables the collection of non-observable, subjective, personal data such as dream and nightmare experiences using a sleep journal-type entry or answers to standardized questions regarding fatigue, emotional responses and night waking.



- the effects of total and partial sleep deprivation:
  - loss of REM and NREM sleep
  - sleep recovery patterns including amount of sleep required, REM rebound and microsleeps
  - sleep-wake cycle shifts during adolescence compared with child and adult sleep including delayed onset of sleep and need for sleep

### Total Sleep Deprivation

#### Psychological effects:

- few serious effects and they are mainly temporary
- problems with attention
- confusion
- misperception
- **MAKE MORE ERRORS IN SIMPLE, BORING TASKS** there is little difference in complex, interesting tasks.

#### Physiological effects:

- shaking (especially the hands)
- drooping eyelids
- difficulty focussing the eyes
- increased sensitivity to pain

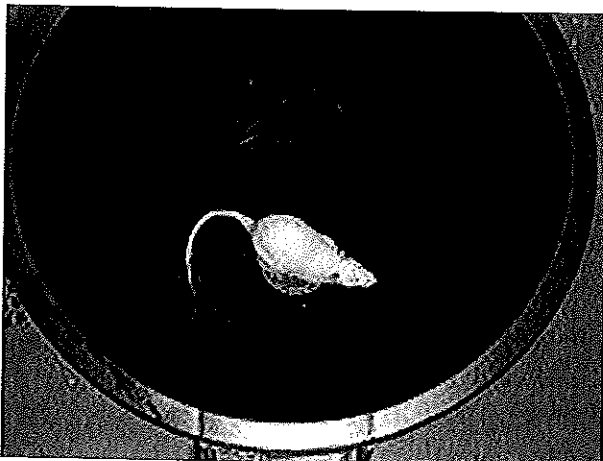
#### AFTER 5 Consecutive days and nights

- heart rate falls
- respiratory rate slows
- biochemical changes and may experience hallucinations or delusions

Sleep deprivation may desynchronise other body rhythms – which can be restored after sleep/wake cycle returns to normal. It is often difficult to ensure that subject is asleep – after 3-4 days people automatically drift into *microsleeps* where the person is apparently awake but EEG recordings show alpha – theta waves – like in Stage One of NREM sleep. There may be no recollection of events from a microsleep.

### Partial sleep deprivation

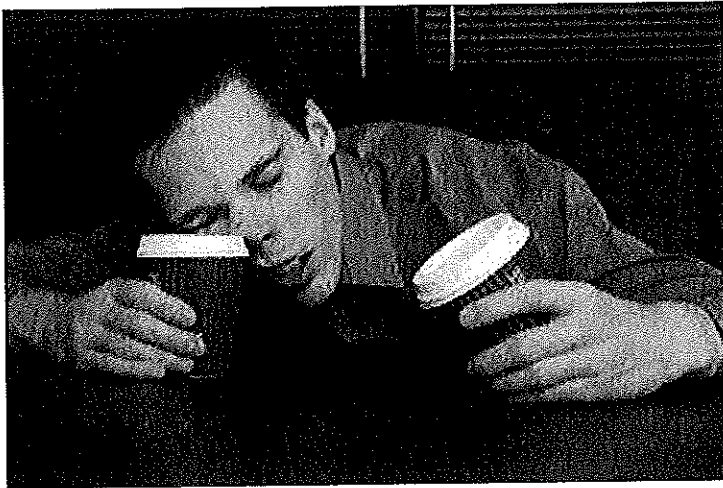
(usually of REM sleep) includes depriving the participant of one stage or type of sleep. Research into partial sleep deprivation was carried out by Dement who had 8 volunteers who agreed to spend a week in a sleep lab being deprived of REM sleep. Whenever their EEG and eye movements indicated they were entering REM sleep they were woken up and kept awake for a few mins. The volunteers were then allowed to go back to sleep until they entered REM sleep again. Over the course of the nights, the participants had to be woken more and more frequently. On the first night they were woken an average of 12 times but by the last night they were woken around 26 times. During this period, they reported mild personality changes such as irritability, anxiety and impaired concentration. When the participants were allowed to sleep normally there was a 10% increase in the amount of time spent in REM sleep. This is called REM rebound.



This rat is being deprived of restful REM sleep by an animal researcher using a single platform ("flower pot") technique. The water is within 1 cm of the small flower pot bottom platform where the rat sits. At the onset of REM sleep, the exhausted rat will either fall into the deep water only to clamber back to its pot to avoid death from drowning, or its nose will become submerged into the water startling it back to an awakened state.

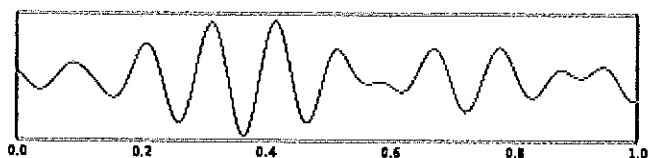
### Sleep cycles of adolescents

Sleep patterns change during an individual's life. In fact, age affects sleep more than any other natural factor. Newborns sleep an average of 16 to 18 hours per day. By the time a child is three to five years old, total sleep time averages 10 to 12 hours, and then it further decreases to 7 to 8 hours per night by adulthood. One of the most prominent age-related changes in sleep is a reduction in the time spent in the deepest stages of NREM (Stages 3 and 4) from childhood through adulthood. In fact, this change is prominent during adolescence, when about 40 percent of this activity is lost and replaced by Stage 2 NREM sleep. In addition to these changes, the percentage of time spent in REM sleep also changes during development. Newborns may spend about 50 percent of their total sleep time in REM sleep. In fact, unlike older children and adults, infants fall asleep directly into REM sleep. Infant sleep cycles generally last only 50 to 60 minutes. By two years of age, REM sleep accounts for 20 to 25 percent of total sleep time, which remains relatively constant throughout the remainder of life.



Psychologists have identified a shift in the body clock from child to adolescent, at about age 12 or 13. While an adult can sleep seven hours and wake refreshed for the day, seven hours equals sleep deprivation for a teenager. This shift can also be seen in adults, when it returns to a rhythm similar to that of the younger child. In fact, Psychologists recommend that adolescents sleep for nine hours fifteen minutes each night to be completely rested, more than any other age group, save infants.

## ACTIVITY



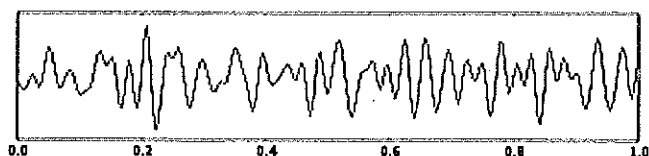
Alpha WAVE

low AMPLITUDE high FREQUENCY

STAGE OF SLEEP:

Relaxing

OTHER FEATURES OF THIS STAGE OF SLEEP

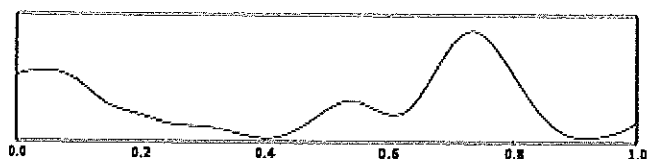


Alpha Beta WAVE

low AMPLITUDE high FREQUENCY

STAGE OF SLEEP:

OTHER FEATURES OF THIS STAGE OF SLEEP

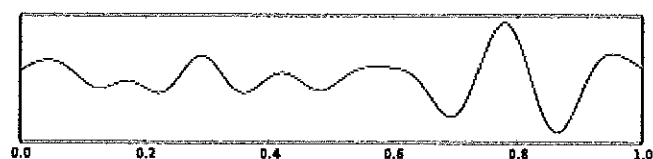


Theta WAVE

high AMPLITUDE low FREQUENCY

STAGE OF SLEEP:

OTHER FEATURES OF THIS STAGE OF SLEEP



Delta WAVE

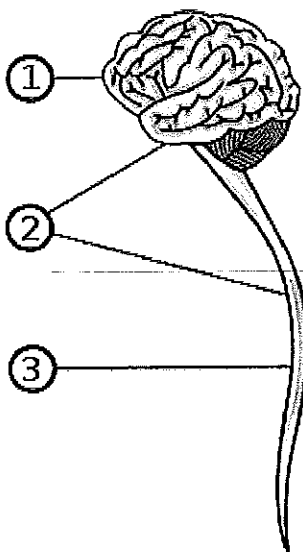
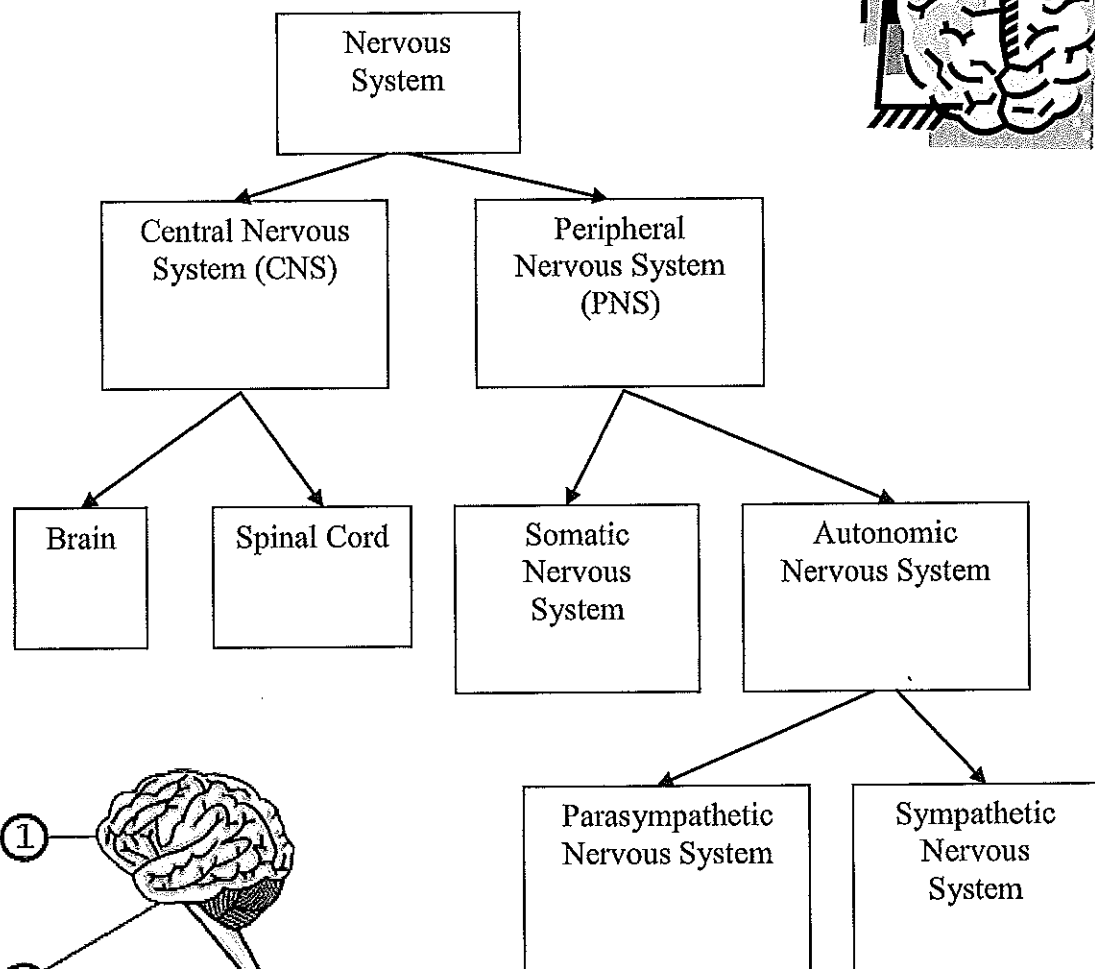
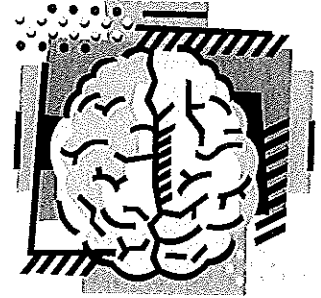
high AMPLITUDE low FREQUENCY

STAGE OF SLEEP:

OTHER FEATURES OF THIS STAGE OF SLEEP



- the interaction between cognitive processes of the brain and its structure including:
  - roles of the central nervous system, peripheral nervous system (somatic and autonomic), and autonomic nervous system (sympathetic and parasympathetic)
  - roles of the four lobes of the cerebral cortex in the control of motor, somatosensory, visual and auditory processing in humans; primary cortex and association areas
  - hemispheric specialisation: the cognitive and behavioural functions of the right and left hemispheres of the cerebral cortex, non-verbal versus verbal and analytical functions
  - the role of the reticular activating system in selective attention and wakefulness; role of the thalamus in directing attention and switching sensory input on and off



### CENTRAL NERVOUS SYSTEM

1. BRAIN
2. CENTRAL NERVOUS SYSTEM
3. SPINAL CORD

## THE CENTRAL NERVOUS SYSTEM

- The Central Nervous System consists of the neurons in the brain and spinal cord..

## THE PERIPHERAL NERVOUS SYSTEM

- The Peripheral NS is the complete set of neurons located outside the CNS.

## COMPARISON TO THE CNS –

- The role of the CNS is to *integrate and co-ordinate* all of the incoming neural information and to *initiate neural messages* to the rest of the body.
- The role of the PNS is to carry information from the sensory and internal organs **TO** the CNS and to carry information **FROM** the CNS to muscles, organs and glands.

**SOMATIC NERVOUS SYSTEM** – Transmits information **from sensory receptors** to the CNS and controls **voluntary movement of skeletal muscles** – controlling muscles attached to bones that produce observable movement, muscles both expand and contract in response to messages from the CNS.

**AUTONOMIC NERVOUS SYSTEM** -- Connects the CNS to internal muscles (diaphragm, iris), glands (adrenal, sweat glands) and organs (heart and lungs). The ANS is autonomic and although it is influenced by the brain, it is primarily self-regulatory. It works independently of our conscious awareness – therefore continues to maintain our survival when awake, during sleep or even in a coma.

Rather than initiating responses like the Somatic Nervous System, the ANS generally **modulates** activity in visceral muscles, organs and glands.

The sympathetic branch of the ANS is involved in the **FIGHT OR FLIGHT** response, which occurs without our control when a psychological or physical threat is perceived. It results in a physiological state of arousal preparing the body to either **Fight** - deal with the threat or **Flight** – run away to safety.

SYMPATHETIC NERVOUS SYSTEM	PARASYMPATHETIC NERVOUS SYSTEM
<p>• prepares the body to deal with stressful or threatening situations. <i>Survived</i></p> <ul style="list-style-type: none"><li>- Sends a message to adrenal glands to produce adrenalin and nor-adrenalin</li><li>- ↑ heart rate</li><li>- ↑ breathing rate – ie. more oxygen</li><li>- ↑ blood pressure</li><li>- ↑ sugar and fat are released to provide energy to muscles</li><li>- pupils dilate to let in more light and reduces production of tears</li><li>- sweat glands ↑ production of perspiration to cool the body</li><li>- ↓ digestive process - ↓ stomach contractions</li><li>- ↓ production of saliva (dry mouth)</li><li>- inhibits release of bile</li><li>- relaxes bladder</li><li>- excites genitals</li></ul>	<p>• Maintains homeostasis (constant internal body environment) OR counterbalances the activities of the Sympathetic Nervous System. <i>Does</i></p> <ul style="list-style-type: none"><li>- Inhibits production of adrenalin</li><li>- ↓ heart rate</li><li>- ↓ breathing rate</li><li>- ↓ blood pressure</li><li>- ↓ release of sugar into bloodstream</li><li>- pupils constrict and normal production of tears</li><li>- ↓ production of perspiration</li><li>- ↑ digestive process ↑ stomach contractions</li><li>- ↑ production of saliva</li><li>- stimulates the release of bile – gall bladder</li><li>- increases contractions of bladder</li><li>- relaxes genitals</li></ul>

Learn the acronym FPOT (Frontal, Parietal, Occipital, Temporal) to remember the names of the four lobes.

To recall the location of the key functional areas within the cerebral cortex (as listed in the study design), use the first letters of the following sentence as a trigger: **A Big Man Sings Very Well**

These letters begin:

Auditory Cortex, Broca's Area, Motor Cortex, Somatosensory Cortex, Visual Cortex and Wernicke's Area

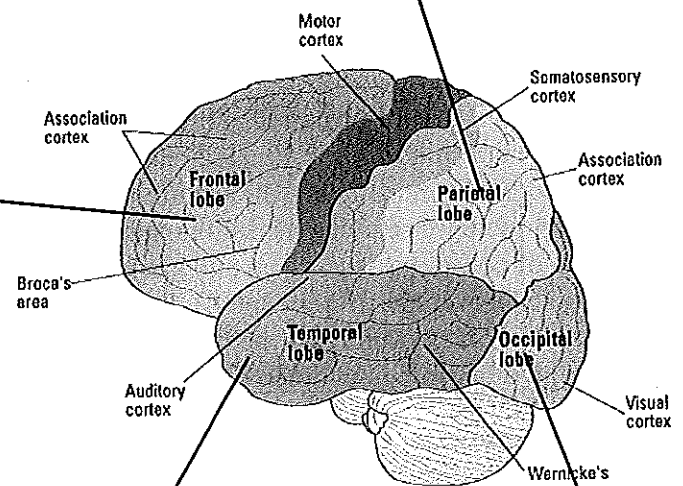
The same alphabetical sequence links these areas in a clockwise direction when looking at the left hemisphere of the brain.

### Functions of the Four Lobes.

Each of the four lobes contain specialised areas for processing either motor or sensory information – these are primary cortex areas: primary motor cortex, primary somatosensory cortex, primary visual cortex and primary auditory cortex. The remaining areas of each of the four lobes are called **association areas**. These areas integrate information from the senses to form perceptions and memories (parietal, occipital and temporal lobes) and are involved in planning movements or making judgements (frontal lobe).

***Parietal Lobes*** – Contain the **somatosensory cortex** which functions include receiving sensory information from the skin (regarding pressure, temperature and pain) and also from the muscles and tendons (regarding body position and movement) and from the internal organs. Like the motor cortex, each hemisphere is responsible for the opposite side of the body – in this case sensations from the right side of the body are processed in the left hemisphere. Areas at the top of the somatosensory cortex receive information from the lower parts of the body and vice versa. Association areas of the Parietal lobes include the integration of visual information and spatial reasoning.

***Frontal Lobes*** – Contain the **primary motor cortex**, which is a highly specialised area that controls movement. Its function is to control the voluntary movements of skeletal muscles. Each area of the motor cortex is responsible for the movement of a specific part of the body. The motor cortex in each hemisphere directs the movement of the opposite side of the body, and areas on the top of the motor cortex control the movements of the lower half of the body, and vice versa. The frontal lobe in the **left hemisphere** also contains **Broca's Area** which is responsible for speech production. Damage to this area results in Broca's Aphasia (difficulty producing speech – although the words produced are usually meaningful, but not grammatically correct). The association areas of the frontal lobe are involved in higher mental functioning such as planning, decision-making, judgement and thinking. It has also been associated with personality and the expression of emotion.



***Occipital Lobes*** – Contain the **primary visual cortex**, which specialises in the processing of visual information from the retinae. It is also involved in the integration of visual information from other areas of the brain.

***Temporal Lobes*** – Functions include receiving auditory information, memory and face recognition. Contains the **primary auditory cortex** responsible for processing auditory information. Also contains **Wernicke's Area**. Damage to this area produces Wernicke's Aphasia (poor speech comprehension and the production of meaningless speech). The association areas of the Temporal Lobes enable memory, object recognition and face recognition.

### Hemispheric Specialisation.

This refers to the dominance of each hemisphere in particular functions and tasks. These can be divided into cognitive and behavioural functions.

Cognitive functions – include mental processes such as memory, perception and language.

Behavioural functions – include observable acts.

Left Hemisphere – is **verbal** and **analytical** (specialises in processing and producing language, logical problem solving and systematic analysis). Remember that the Left hemisphere controls Language and Logical tasks... remember the **Ls**! The left hemisphere processes information in a sequential and logical manner. It also controls the movement of the *right* side of the body.

Right Hemisphere – is **non-verbal** (spatial, creative, recognition, art and music appreciation). The right hemisphere processes information in an holistic manner. It also controls the movement of the *left* side of the body.

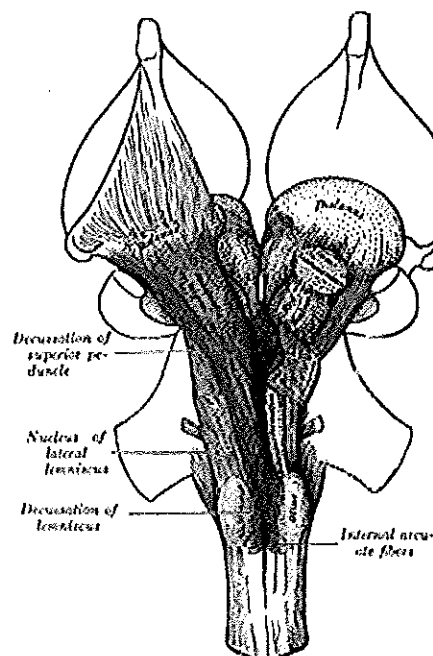
### The role of the reticular activating system in selective attention and wakefulness; role of the thalamus in directing attention and switching sensory input on and off

The **reticular activating system** is the name given to part of the brain (the Reticular Formation and its connections) believed to be the **centre of arousal and motivation** in animals (including humans). It is situated between the brain stem and the central nervous system (CNS).

It is involved with the **sleep/wake cycle**; damage can lead to permanent coma. It is thought to be the area affected by many psychotropic drugs. General anesthetics work through their effect on the Reticular Formation.

The reticular activating system also helps mediate transitions from relaxed wakefulness to periods of high **attention**. There is increased blood flow (presumably indicating an increased measure of neuronal activity) in the midbrain reticular formation (MRF) and thalamic intralaminar nuclei during tasks requiring increased alertness and attention.

The **thalamus** is a midline paired symmetrical structure within the brain (it is like two egg-shaped parts – one in each hemisphere). It is situated between the cerebral cortex and midbrain, both in terms of its location and neurological connections. The thalamus is located under the cortex, deep within the hemispheres. Its function includes relaying sensation, spatial sense and motor signals to the cerebral cortex, along with the regulation of consciousness, sleep and alertness. The two important roles are: enabling attention by receiving sensory input (except smell). It relays this information to the appropriate cortices. The thalamus is considered the relay station for the brain, shuttling information between sensory neurons and the cerebral cortex. The other role is in determining which aspects of a stimulus requires our attention.





• contribution of studies to the investigation of cognitive processes of the brain and implications for the understanding of consciousness including:

- studies of aphasia including Broca's aphasia and Wernicke's aphasia
- spatial neglect caused by stroke or brain injury
- split-brain studies including the work of Roger Sperry and Michael Gazzaniga
- perceptual anomalies including motion after-effect, change blindness, synaesthesia

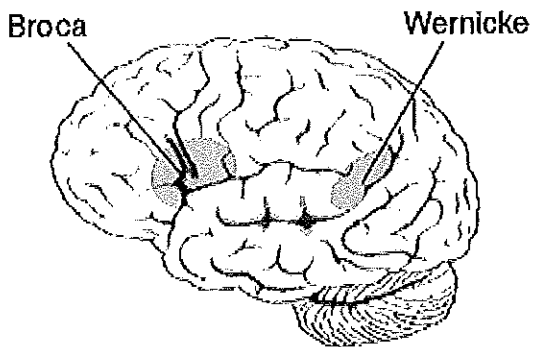
\* For each of the following studies, consider the implications for understanding consciousness.

### Broca and Wernicke's areas:

- Broca's area is located in the left frontal lobe and is responsible for speech production

Damage to Broca's area is called Broca's Aphasia. It results in difficulty producing speech and an inability to create complete, grammatically correct sentences. Only the main content words are produced. Patients usually have little problems comprehending language.

■ Wernicke's area is located in the left temporal lobe and is responsible for comprehending language. Damage to Wernicke's area is called Wernicke's Aphasia. It results in difficulty in comprehension of language. Speech is produced and is usually grammatically correct, with a natural-sounding rhythm; however it is vague and meaningless and may include nonsense words.



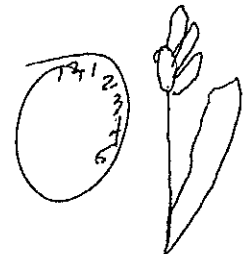
### LEARNING TIP

Associate the mouth both with speech production and being with being at the front.

Associate an ear both with comprehending language and with being next to the temporal lobe.

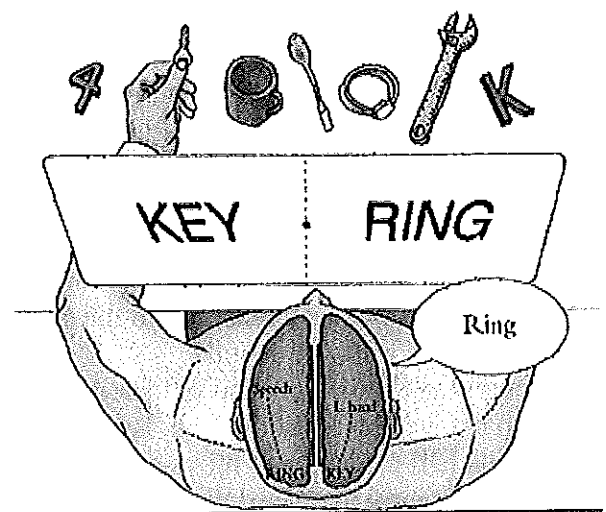
### Spatial Neglect

Spatial neglect is a common syndrome following stroke, most frequently of the right hemisphere. Up to two-thirds of acute right-hemisphere stroke patients demonstrate signs of contralesional neglect, failing to be aware of objects or people to their left in extrapersonal space. For example, when searching through a visual scene patients with left neglect tend to look at elements on the right only. The syndrome may also involve 'personal' space, with patients neglecting their own contralesional body parts. Importantly, many patients are unaware they have these problems (anosognosia).



### Split-brain studies

Patients who have had the corpus callosum severed as treatment for epilepsy have served as unique participants in a range of studies. Some split-brain studies have been experimental using animals, but these are not as relevant to examining consciousness. From such tests we can discover the amazing effects of disconnection. Over the years hundreds of experiments have been carried out, and they mainly reveal that the thoughts and perceptions of one hemisphere go on outside the realm of awareness of the other. The left brain is crammed with devices that give humans an edge in the animal kingdom. This is the hemisphere that is adept at problem solving and thinking. While the right brain is better at things like facial recognition, the left brain is crucial for our intelligence agency. The split-brain patient seems to have two minds. What the left brain learns and thinks is unknown to the right brain, and vice versa.



### **Perceptual anomalies: motion after-effect, change blindness, synaesthesia**

The **motion after-effect** (MAE) is a visual illusion experienced after viewing a moving visual stimulus for a time (seconds to minutes) with stationary eyes, and then fixating a stationary stimulus. The stationary stimulus appears to move in the opposite direction to the original (physically moving) stimulus. The motion aftereffect is believed to be the result of motion adaptation.

In visual perception, **change blindness** is the phenomenon that occurs when a person viewing a visual scene apparently fails to detect changes in the scene. These phenomena are attracting an increasing amount of attention from experimental psychologists and from philosophers, because they suggest that humans' internal representation of the visual world is much sparser than usually thought. The outside world serves as a form of "external memory" and only those aspects of the environment that are currently being "visually manipulated", are actually available for conscious processing at a given moment. We have the impression of seeing everything because we know we have access to everything, even though without actually accessing something, no detailed information is available about it. This explains the apparent paradox between the feeling of richness we have of our visual environments, and our striking inability, in change blindness experiments, of knowing what has changed.

**Synaesthesia** is a neurologically-based condition in which stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway. Grapheme → colour synaesthesia is a form of synaesthesia in which an individual's perception of numbers and letters is associated with the experience of colours. Like all forms of synaesthesia, grapheme → colour synaesthesia is involuntary, consistent, and memorable. Grapheme → colour synaesthesia is one of the most common forms of synaesthesia, and because of the extensive knowledge of the visual system, one of the most studied. Many researchers are interested in synaesthesia because it may reveal something about human consciousness. One of the biggest mysteries in the study of consciousness is what is called the "binding problem." No one knows how we bind all of our perceptions together into one complete whole. For example, when you hold a flower, you see the colours, you see its shape, you smell its scent, and you feel its texture. Your brain manages to bind all of these perceptions together into one concept of a flower. Synaesthetes might have additional perceptions that add to their concept of a flower. Studying these perceptions may someday help us understand how we perceive our world.

• the application and use of brain research methods in **investigating the relationship between biological and cognitive factors** of human behaviours including:

- direct brain stimulation and transcranial magnetic stimulation (TMS)
- brain recording and imaging techniques: computed tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), and functional magnetic resonance imaging (fMRI)

### **Direct brain stimulation and transcranial magnetic stimulation (TMS) investigating the relationship between the biological and cognitive aspects of human behaviour.**

Aslihan Selimbeyoglu and Josef Parvizi (2010) summarised a number of studies using ESB investigating cognitive function and the brain. Stimulations in the temporal and temporo-occipital structures were associated with hallucinations in the visual domain such as seeing a face, geometric shapes, and color or blurring of vision, visual movement, things looking sideways, and lines seeming out of kilter. In addition, disruption in reading, or reading comprehension, picture naming and or identification were also reported with left inferior temporal lobe stimulations.

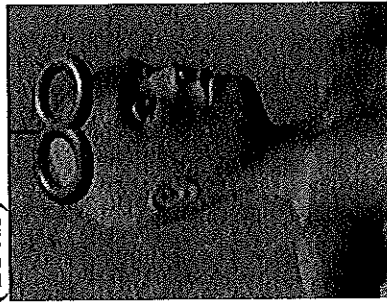
TMS has been applied successfully to the study of cognitive studies with TMS tasks that require the integration of sensory input and

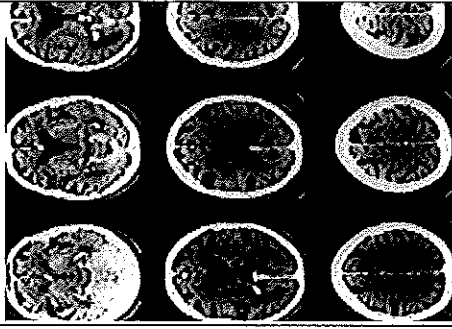
motor output. Schluter et al. investigated the timing of premotor and primary motor cortex activity in a simple choice reaction time task. Brasil-Neto et al stimulated the left or right motor cortex while participants had to choose to move either their left or right index finger. TMS over the left or right motor cortex significantly increased the probability of participants 'choosing' to move their opposite finger.

### Brain recording and imaging techniques investigating the relationship between the biological and cognitive factors of human behavior.

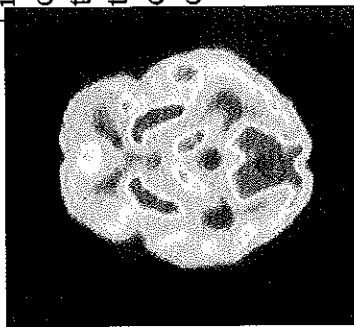
Devices that record the **structure** of the brain (such as CT scans and MRIs) investigate the localization of areas of the brain that have been damaged by tumours, stroke, injury and disease and correlate that with cognitive abilities that are affected or remain intact (as in Broca and Wernicke's areas). Studies using fMRIs, PET and SPECT scans show function through changes in blood flow or glucose to various parts of the brain and are usually coupled with structural scans to show specific areas of brain function associated with various cognitive tasks.

Brain research method	Description	Value	Limitations
<b>Brain Stimulation</b>	Electrical brain stimulation (also ESB in some texts): A small electrode is placed on, or inserted into, the brain to stimulate or inhibit electrical activity, in order to determine specific locations of brain function.	ESB enabled some early brain 'mapping', and is quite accurate in indicating specific areas of the brain function. It provides accurate information that is specific to the individual and is effectively used with patients prior to surgery, to determine localisation of function.	Only really relevant for patients about to undergo surgery, as it is so invasive. Animals are also used, which has ethical issues and limitations regarding generalisation of findings. Other limitations are in regards to problems forming conclusions and generalisations from the results of brain damaged patients.
<b>Transcranial Magnetic Stimulation (TMS)</b>	Transcranial magnetic stimulation (TMS) is a method of inducing a flow of electrical current within neurons by the external application of a magnetic field. In this respect, it can be thought of as having some similarities to electro-convulsive therapy (ECT). TMS uses electromagnetic induction to generate an electric current across the scalp and skull without physical contact. A plastic-enclosed coil of wire is held next to the skull and when activated, produces a magnetic field oriented orthogonally to the plane of the coil. The magnetic field passes unimpeded through the skin and skull, inducing an oppositely directed current in the brain that activates nearby nerve cells in much the same way as currents applied directly to the cortical surface. The magnetic field penetrates only to a maximum depth of three centimeters into the brain,	This is similar to ESB and ECT without the same level of invasiveness. Still in it's early years, there is still a wide range to future research possible using TMS.	An important limitation of TMS is that there is a limited knowledge concerning its physiological effects, which often make the interpretation of TMS results ambiguous. This results in the need for a combination of research methods when using TMS.



	<p>in the area directly adjacent to the coil.</p> <p>The patient is normally seated and is fully conscious. A special cap is placed on his/her head that has the markings on it for the coil positions. Electrodes are placed on the scalp, which monitor the motor evoked potentials produced by the observable muscle movement. The first part of the procedure is called mapping. During this, the patient's motor threshold is established. The motor-threshold is taken to be a measure of the person's cortical excitability and allows calibration for the strength of the stimulus needed.</p>		
<p><b>Computerised tomography</b></p> 	<p>Also referred to as Computerised Axial Tomography or CAT). The patient is injected with a dye to increase the contrast between features of the brain, then the patient lies on a CT scanner bed while X-rays are passed through the body to produce an image. Scans and X rays are two-dimensional pictures with the tissues, organs and bones represented in various shades of gray. A number of X-rays are taken from various angles around the head, and a computer compiles the various images.</p>	<p>Provides a detailed image of the structure of the brain and any abnormalities in structure (such as tumours, strokes) and is providing information about the structural differences in patients with illnesses such as Schizophrenia and Parkinson's disease.</p>	<p>CT scans only show structure. They do not indicate function nor activity. Although only low levels of radiation are used, there is some risk involved in X-ray scans.</p>

## Positron Emission Tomography



PET scans indicate brain function, by assuming that increased blood flow to an area of the brain indicates an increase in activity. A small dose of a chemical, containing a radioactive isotope, is given to the patient, then as an area of the brain is active, the radioactive substance emits signals that are detected by gamma ray detectors, which are compiled into images on a computer.

Used to show brain function in normal as well as brain-damaged patients. PET scans have been used in research to determine different areas of brain function and the level of activity for various tasks, and can also indicate brain damage or tumour activity.

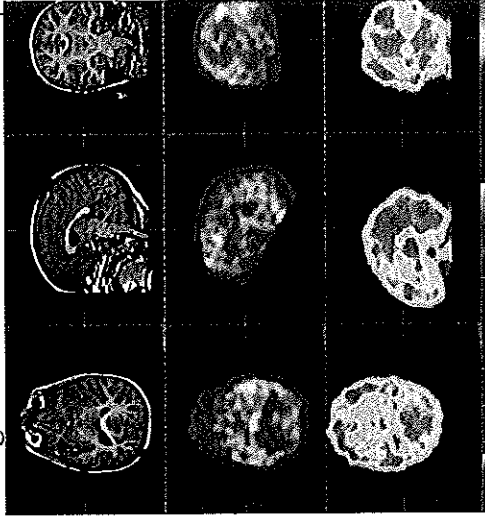
Due to the use of a radioactive substance, sessions must be kept short and the individual scans take about 30 seconds to complete, and require a 40 second interval between each scan. This doesn't give an indication of the continual process of brain activity. PET scans do not necessarily show a direct relationship between the task and brain activity, as a number of factors may also cause changes measured by the PET scan.

## Single Photon Emission Computed Tomography SPECT

SPECT is able to provide true 3D information. The basic technique requires injection of a gamma-emitting radioisotope into the bloodstream of the patient. The gamma-emitting tracer used in functional brain imaging emits gamma rays which are detected by a gamma camera. When it is taken up by brain tissue in a manner proportional to brain blood flow, this allows brain blood flow to be assessed with the nuclear gamma camera. Because blood flow in the brain is tightly coupled to local brain metabolism and energy use, the gamma-emitting tracer is used to assess brain metabolism regionally, in an attempt to diagnose and differentiate the different causal pathologies of dementia.

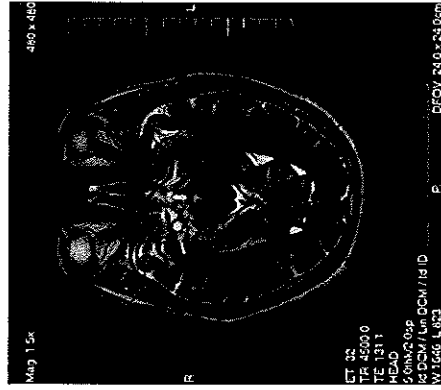
SPECT provides a 3D image. In meta analysis, SPECT was superior to clinical exam and clinical criteria (91% vs. 70%) in being able to differentiate Alzheimer's disease from vascular dementias. SPECT is more widely available than PET scans as the radioisotope generation technology is longer-lasting and far less expensive in SPECT, and the gamma scanning equipment is less expensive as well.

Poor resolution/detail in comparison to MRI. There is some exposure to radiation and a limit as to the number of SPECT scans that participants can undergo.



## Magnetic Resonance Imaging

MRI doesn't read tissue density like a CTscan - it applies a large magnetic field to find the location of hydrogen atoms in the body (mostly in water and fat) to create a picture of tissue structure.



Shows detailed structure of the brain, in greater detail than a CT scan, and can detect some abnormalities in tissue. The technique does not display bone like a CT scan, but because bone is largely invisible to it, the MRI can reveal the soft tissues that bone otherwise obscures- such as the spinal cord or the base of the brain. It does not use radioactive substances nor x-rays, and is therefore less harmful than some other methods.

MRIs do not show function, only structure. They cannot be used with some patients, with pacemakers or pins in bones.

## Functional Magnetic Resonance Imaging



This procedure begins like an MRI, and a single high-resolution scan is taken. Several low-resolution colour images are then taken, which can detect changes in blood flow due to the iron contained in the haemoglobin (iron has magnetic properties that can be detected). These colour images can be combined with the original structural image of the MRI to show structure **and** function.

Shows structure and function of specific areas of the brain, and is more detailed than CT and PET scans. fMRIs can be used with normal and brain damaged patients, and can record images during activities. fMRIs can take far more images, far more quickly than PET scans, thus showing continuous changes in brain activity. fMRIs also don't require any exposure to radiation.

Similar to the PET scan, in that changes in brain activity, may be due to factors other than the task itself – such as difficulty. fMRIs are also very expensive.

- research methods and ethical principles associated with the study of the brain and states of consciousness, as outlined in the introduction to the unit.

SEE NOTES AT THE END OF BOOKLET



## AREA OF STUDY 2

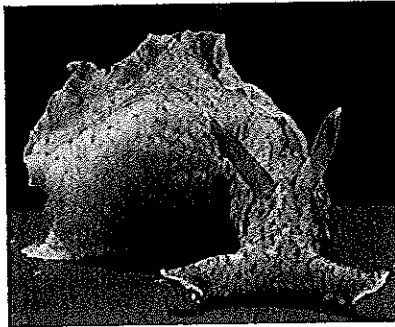
### Memory

- mechanism of memory formation:
  - role of the neuron in memory formation informed by the work of E. Richard Kandel
  - roles of the hippocampus and temporal lobe
  - consolidation theory
  - memory decline over the lifespan
  - amnesia resulting from brain trauma and neurodegenerative diseases including dementia and Alzheimer's disease

### Memory formation

New research has shown that when you learn, and when you recall what you've learned, you reactivate the same neurons used during the original experience. The new results suggest that the affected neurons evolved stable synaptic changes, giving them a capacity for reactivation by conditioned stimulus for at least three days

Eric Kandel started to study learning and memory in mammals, but realized that the conditions were too complex to provide an understanding of basic memory processes. He therefore decided to investigate a simpler experimental model, the nervous system of a sea slug, *Aplysia*. It has comparatively few nerve cells (around 20,000), many of which are rather large. It has a simple protective reflex that protects the gills, which can be utilized to study basic learning mechanisms.



Eric Kandel found that certain types of stimuli resulted in an amplification of the protective reflex of the sea slug. This strengthening of the reflex could remain for days and weeks and was thus a form of learning. He could then show that learning was due to an amplification of the synapse that connects the sensory nerve cells to the nerve cells that activate the muscle groups that give rise to the protective reflex.

### Role of the hippocampus and temporal lobe

The role of the hippocampus in memory formation was investigated following a unique case study in 1957 by Scoville and Milner describing the effects of bilateral medial temporal lobe resection on memory function. One of the subjects in the report, H. M., is considered the index case of amnesia resulting from temporal lobe injury. H. M. suffered with frequent generalized seizures that were not adequately controlled by anticonvulsant therapy. The surgery was a radical experiment that was felt to be justified by the patient's incapacitation and lack of response to available treatment. H. M.'s bilateral medial temporal lobe resection included the hippocampal formation and the effect of the surgery on his memory was dramatic and immediately evident. Formal neuropsychological testing demonstrated dense amnesia for all events following the surgery and intact memory for events that occurred prior to 19 months preceding surgery. Scoville and Milner concluded that the hippocampus was crucial for the formation of memory to recent events.

The temporal lobes are highly associated with memory skills. Left temporal lesions result in impaired memory for verbal material. Right side lesions result in recall of non-verbal material, such as music and drawings.

### **Consolidation theory**

- Accounts for the transition of information from STM to LTM
- Process assumes long-term neurophysiological changes that allow for the relatively permanent retention of information
- If neuronal activity involved in encoding information is maintained for sufficient time, long-term neurophysiological changes will occur as information is consolidated
- If this neuronal activity is interrupted, information is not consolidated and lost
- Evidence – Retrograde amnesia sufferers experience loss of memory for events before the traumatic event causing the amnesia (injury, ECT)

### **Memory decline over the lifespan**

Many people show no age-related memory decline

Stay intact:

- Semantic memories
- Procedural memories

Steady decline:

- Episodic memories

Age-related decline:

- Ability to recall newly learned material
- Due to age-related factor, motivation and loss of confidence

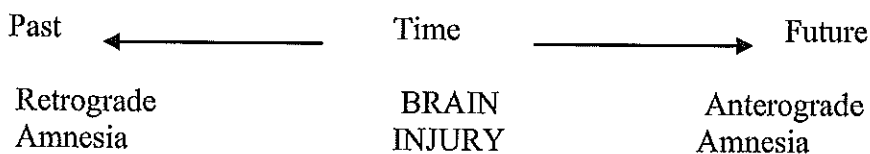
### **Amnesia**

#### **Anterograde amnesia**

- Loss of memory for events or experiences after the traumatic event that caused the amnesia
- Generally affects declarative memory but not procedural memory

#### **Retrograde amnesia**

- Loss of memory for events or experiences before a traumatic event that caused the amnesia
- Memories are generally recovered gradually, starting with early memories
- The traumatic event is not always remembered



### **Dementia**

Dementia is a term for a large number of disorders that can affect thinking and memory. They are generally progressive and cause amnesia. The most common form of dementia is Alzheimer's Disease, which currently accounts for between 50 and 70 per cent of dementias.

**Alzheimer's disease** is a chronic brain disease that gradually erodes an individual's memory, intellectual abilities and personality. It is a neurodegenerative disease characterized by progressive cognitive deterioration together with declining activities

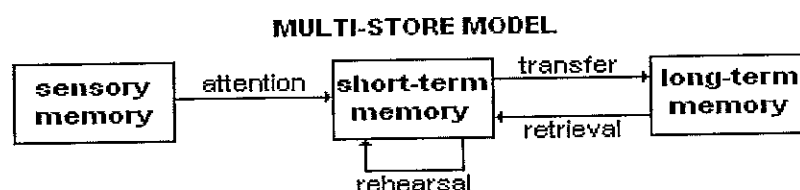
of daily living and neuropsychiatric symptoms or behavioral changes. It is the most common type of dementia.

The most striking early symptom is loss of short term memory (amnesia), which usually manifests as minor forgetfulness that becomes steadily more pronounced with illness progression, with relative preservation of older memories. As the disorder progresses, cognitive (intellectual) impairment extends to the domains of language (aphasia), skilled movements (apraxia), recognition (agnosia), and those functions (such as decision-making and planning) closely related to the frontal and temporal lobes of the brain as they become disconnected from the limbic system, reflecting extension of the underlying pathological process. These changes make up the essential human qualities, and thus AD is sometimes described as a disease where the victims suffer the loss of qualities that define human existence.

This pathological process consists principally of neuronal loss or atrophy, principally in the temporo-parietal cortex, but also in the frontal cortex, together with an inflammatory response to the deposition of amyloid plaques and neurofibrillary tangles.

- comparison of models for explaining human memory:
  - Atkinson-Shiffrin's multi-store model of memory including maintenance and elaborative rehearsal, serial position effect and chunking
  - Alan Baddeley and Graham Hitch's model of working memory: central executive, phonological loop, visuo-spatial sketchpad, episodic buffer
  - levels of processing as informed by Fergus Craik and Robert Lockhart
  - organisation of long-term memory including declarative and episodic memory, and semantic network theory

### Atkinson and Shiffrin Multi-store model of memory



This model was one of the first cognitive models of memory. Criticised for being simplistic, it has provided constructs that have remained examinable throughout the years, such as STM and LTM.

#### *Sensory memory*

- Initial repository of information that enters STM and LTM stores
- Persistence of sensory information after stimulation has ceased
- All stimuli bombarding the senses is registered momentarily in its original sensory form – Stimuli selected for attention are transferred into a more permanent memory store and stimuli not attended to are erased from experience

#### *Iconic memory*

- Visual sensory register
- Information stored in the form of visual images that represent something
- Holds visual information for about 0.3 of a second

### Echoic memory

- Auditory sensory register
- Holds auditory information for 3 – 4 seconds

### Short Term Memory (STM)

Information coming in to short-term memory may experience any of three outcomes:

1. it may be discarded;
  2. it may be retained for a while (by rehearsing it);
  3. or it may be encoded and transferred into long-term memory.
- Limited capacity: 7 +/- 2 items of information. Chunking can increase capacity.
  - Duration approximately 30 seconds if not rehearsed or encoded

### Long Term Memory

- Information enters LTM through encoding or elaboration according to the theory
- It may be retained for up to a lifetime with a potentially unlimited capacity (see notes below for more details re LTM)

### Rehearsal

- Process involved in retaining information in STM or transferring information to LTM
- *Maintenance rehearsal* – Conscious repetition of information (covertly or overtly) in order to retain it in STM
- *Elaborative rehearsal* – Deep processing of information involving interpretation, organisation and association with other information in order to transfer information into LTM

### Serial Position Effect

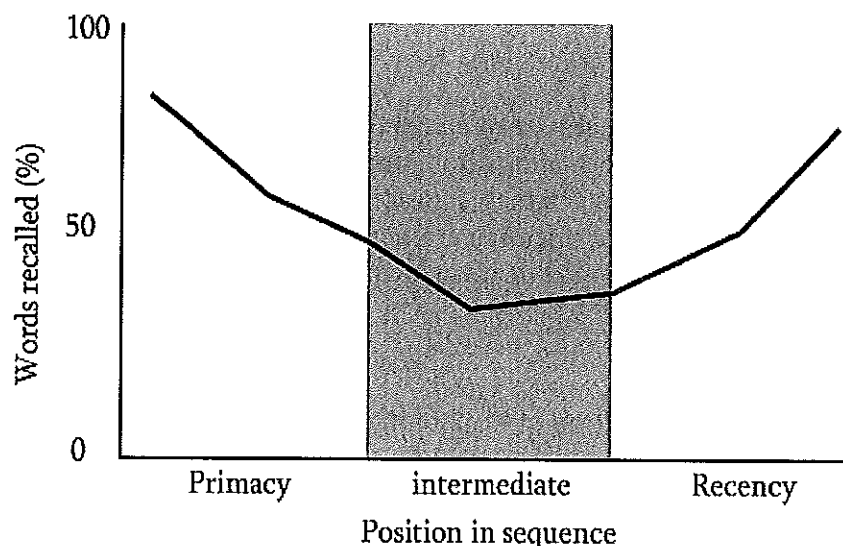
When asked to recall information, there is a tendency for the position of the information in a list (first, last, middle) to influence recall.

#### Primacy Effect

Is the tendency for information at the START of a list to be recalled more easily, due to possible rehearsal and storage in LTM.

#### Recency Effect

Is the tendency for information at the END of a list to be recalled more easily, when recalled immediately following presentation, possibly due to still being in STM.



The serial position effect indicates that the most recently presented information is better recalled because it is still in STM, and that the first pieces of information presented have been stored in LTM.

If there is a time delay before testing recall (or if serial recall is used) the recency effect does not occur – because it has been displaced from STM.

### Chunking

- Grouping together of a number of items of information so that they are processed cognitively as a single entity
- Limitations of STM capacity can be overcome (to some extent) by chunking because the limitation applies to chunks of information

### Baddeley and Hitch - Working Memory Model

The term working memory describes the active processing and storage of information while it's being used

It is an active, three part specialist sub-system of STM where information is temporarily held and mentally manipulated during thinking and problem solving tasks is a complex processing system that is made up of three components

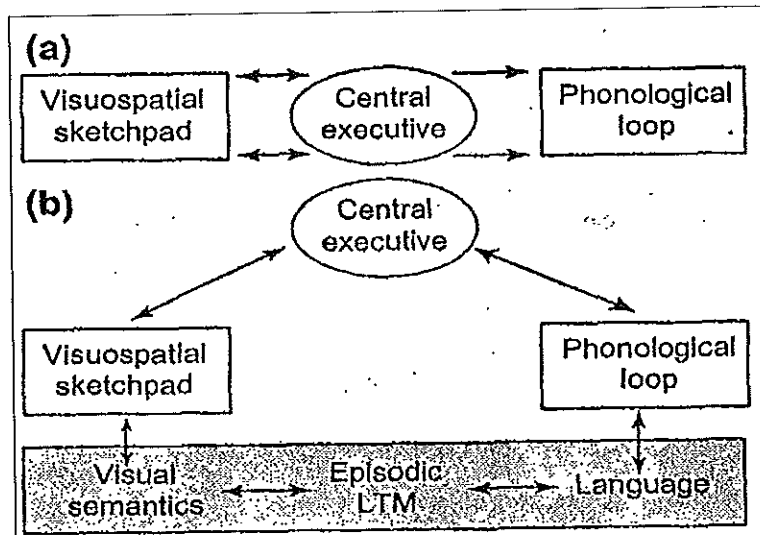
#### Baddeley's (1986) Working Model of Memory

- Visuospatial Sketchpad stores and manipulates visual and spatial information
- Phonological Loop stores traces of acoustic information such as speech that is maintained through articulatory rehearsal (a sub-vocal maintenance type rehearsal)
- Central Executive is the most important part of working memory, that integrates information from the verbal and visual systems and from LTM. It monitors, controls and integrates information.

Baddeley (2000) extended the model by adding a fourth component, the episodic buffer, which holds representations that integrate phonological, visual, and spatial information, and possibly information not covered by the slave systems (e.g., semantic information, musical information). The component is episodic because it is assumed to bind information into a unitary episodic representation. The episodic buffer resembles Tulving's concept of episodic memory, but it differs in that the episodic buffer is a temporary store.

### Model of working memory

- (a) original and  
(b) revised



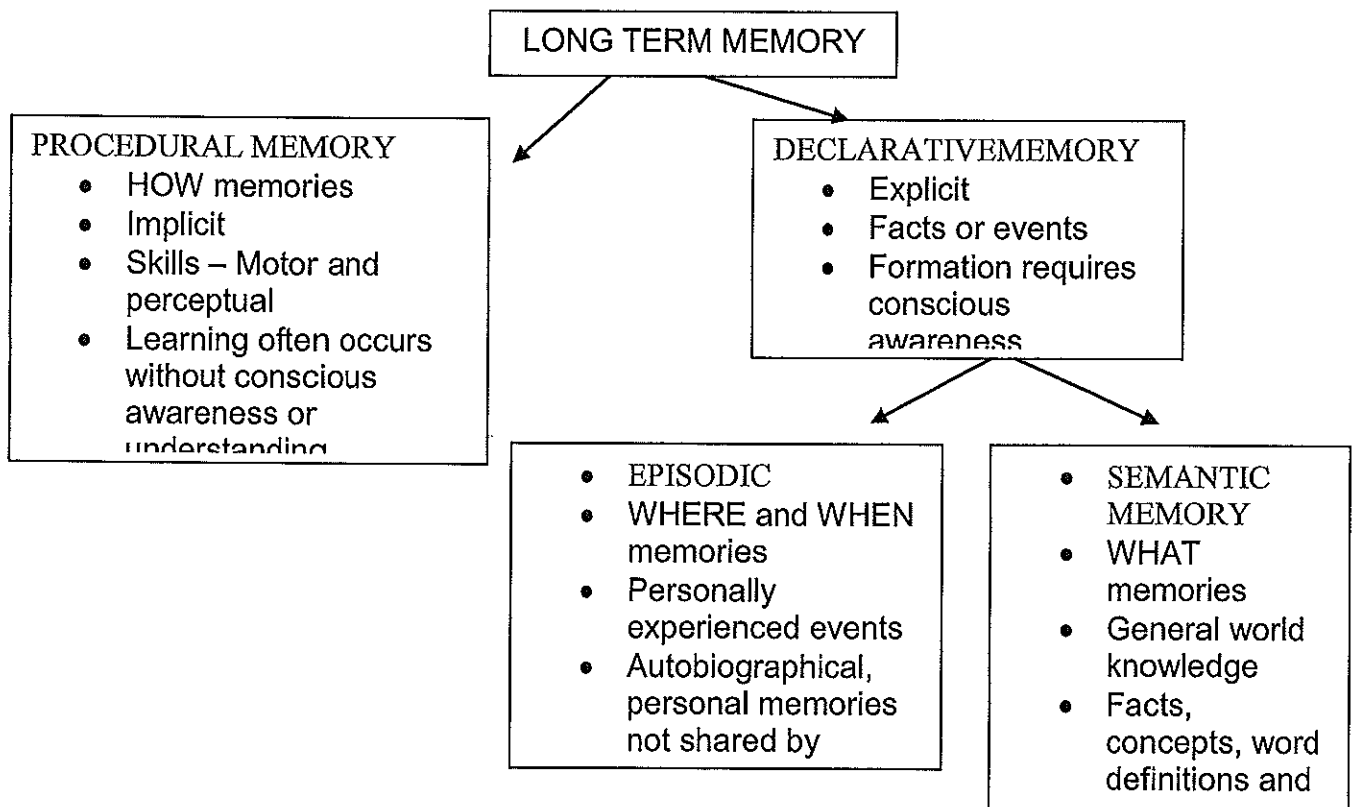
### Levels of Processing – Craik and Lockhart

Psychologists Craik and Lockhart propose that memory is just a by-product of the depth of processing of information and there is no clear distinction between short term memory and long term memory

Depth is defined as "*the meaningfulness extracted from the stimulus rather than in terms of the number of analyses performed upon it.*"

The model suggests that information is processed either at a shallow (structural) level – such as what a word looks like, a phonemic level – such as what the word rhymes with, and a deeper semantic level (the meaning of the word). According to the theory it is the level at which the information is processed that determines storage and later recall.

### Organisation of LTM and Semantic Network Theory



Two Main Types:

■ **Procedural**

- memory for actions or skills, habits, fears, etc.
- knowing 'how' (e.g. how to ride a bike or play tennis)
- largely unconscious and cannot be 'declared' (i.e. not available for inspection, not aware of these memories)

■ **Declarative:**

- memory for facts and events in the world; knowing 'that' (e.g. Tuesday follows Monday, an elephant has large ears)
- Can be made conscious and can be 'declared' (i.e. open for inspection, awareness of what we recall)
- Two types: either *semantic* or *episodic* memory



**Declarative: Episodic**

- Autobiographical record of personal experiences (i.e. knowledge of events, personal experiences, activities)
- Specific memories include the
  - Context (i.e. time and place) and the
  - State (i.e. psychological and physiological condition) the person was in at the time of the event

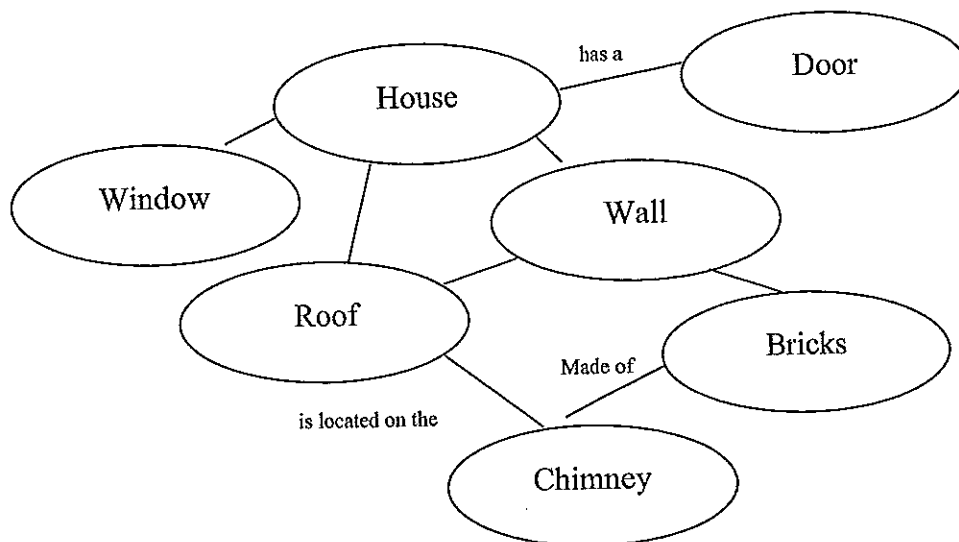
**Declarative: Semantic**

- Information about the world, including general knowledge (e.g. rules, concepts, word meanings and language rules, facts, and specific details about the world)
- Specific memories don't depend on the context or the state the person was in at the time of the event.

**SEMANTIC NETWORK THEORY –**

Proposes that the LTM is systematically organised. Concepts (nodes) are connected by meaningful, overlapping links.

Activation of one concept (node) can activate other related pieces of information.



- strengths and limitations of psychological theories of forgetting:
  - retrieval failure theory including tip-of-the-tongue phenomenon
  - interference theory
  - motivated forgetting as informed by the work of Sigmund Freud including repression and suppression
  - decay theory

**Retrieval failure theory**

- Memories cannot be recalled because correct retrieval cues are not being used
- Forgetting occurs from LTM due to a lack of retrieval cues, or failure to use the right cue to retrieve the information stored there.
- Information is not lost, but inaccessible when needed context-dependent and state-dependent cues can increase the likelihood of retrieving information

forgotten' form episodic memory. Retrieval failure is also called cue-dependent forgetting

Tip of the Tongue phenomenon: This is a great example of retrieval failure theory as we aware that we have a memory of specific information, like the name of a song, but cannot access or retrieve it at that point in time. Yet in a few minutes or later that day, the memory returns. We can often remember the first letter of the word or what the song sounds like or maybe whether it was a long or short name.

#### Interference theory

- Forgetting is influenced more by what we do before or after learning than by the mere passage of time
- Forgetting occurs due to interference between information previously stored in memory and more recently stored information.
- Interference is greater with increasing similarity of information. Interference occurs in both STM and LTM

#### Retroactive interference

- RIFO (Retroactive Interference = Forget Old material)
- Later learning interferes with the recall of earlier learning
- Interference works backwards in time

LEARN LIST A

LEARN LIST B

CANNOT RECALL  
LIST A  
(forget old  
information)

#### Proactive interference

- PIFN (Proactive Interference = Forget New material)
- Earlier learning interferes with the recall of later learning
- Interference works forward in time

LEARN LIST A

LEARN LIST B

CANNOT RECALL  
LIST B  
(forget **new**  
information)

#### Motivated forgetting theory

- Forgetting is a motivated process rather than a failure of learning or other processes (suppression is a conscious form of forgetting)
- Repression refers to an unconscious process in which certain memories are made inaccessible
- Memories which are likely to induce guilt, embarrassment, shame or anxiety are repressed as a form of defence mechanism

#### Decay theory

- Tries to explain why forgetting increases with time
- Proposes that a memory trace (engram) is formed when new information is learned

- Metabolic processes occur over time which cause the engram to degrade or break down unless it is maintained by rehearsal
- This results in the memory contained within the engram becoming unavailable
- Decay from STM due to disruption of active memory trace
- Decay from LTM due to disuse – If certain knowledge or skills are not used or practised for long periods of time the corresponding engram will eventually decay

- manipulation and improvement of memory:
  - forgetting curve as informed by the work of Hermann Ebbinghaus
  - measures of retention including the relative sensitivity of recall, recognition and relearning
  - use of context dependent cues and state dependent cues
  - mnemonic devices including acronyms, acrostics, peg-word method, narrative chaining and method of loci
  - effect of misleading questions on eye-witness testimonies including the reconstructive nature of memory informed by the work of Elizabeth Loftus

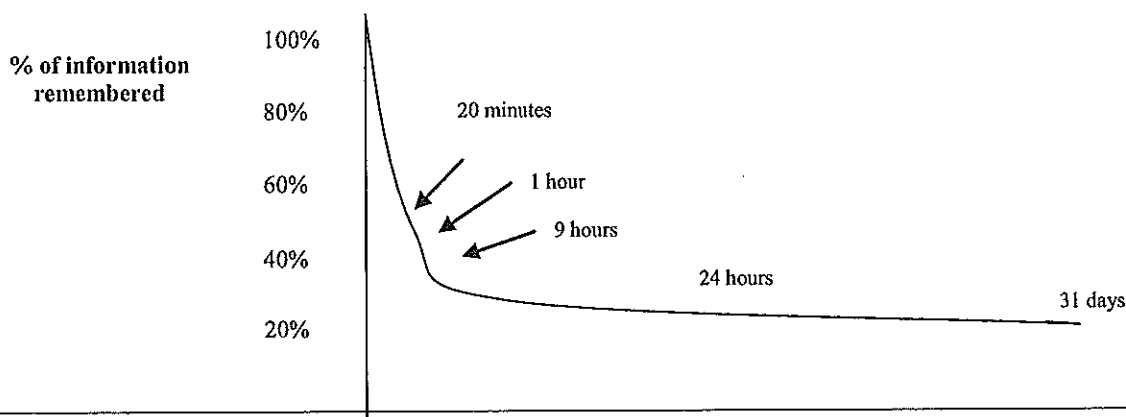
## Forgetting Curve

### Forgetting

- Process by which memories are lost
- Can occur at encoding, storage or retrieval stages
- Availability – Refers to whether or not information is actually stored
- Accessibility – Refers to whether or not information can be retrieved

### Forgetting curve

- In experiments where is used himself as the subject, Ebbinghaus tested his memory using three-letter nonsense syllables. Using previously known words would have made use of previously existing knowledge and associations in his memory.
- In order to test for new information, Ebbinghaus tested his memory for periods of time ranging from 20 minutes to 31 days.
- His results, plotted in what is known as the Ebbinghaus forgetting curve, revealed a relationship between forgetting and time. Initially, information is often lost very quickly after it is learned. Factors such as how the information was learned and how frequently it was rehearsed play a role in how quickly these memories are lost.
- Amount of information retained represented on vertical axis and retention interval (time) represented on horizontal axis
- Gradient of slope indicates rate of forgetting



## Measures of Retention

### Retention

TIME 

- Process of encoding onto or retaining information ie. A measure of retention is any method used to assess how much information has been retained.

### Recall

- Process of reproducing information from memory spontaneously without cues or minimal cues
- Free recall – Retrieval of a number of items of information in any order
- Serial recall – Retrieval of a number of items of information in the order in which they were originally presented
- Cued recall – Retrieval of information with the help of cues (first letter of a word to be remembered)
- Least sensitive measure of retention

### Recognition

- Process of identifying information that has been remembered from a series of alternatives

### Relearning

- Process of learning again material that has been forgotten
- The effort required to learn the information for a second time is less than the effort needed on the initial learning experience, which indicates some memory trace (conscious or not) from the first learning experience
- Method of savings

$$\text{Savings} = \frac{(\text{Time/Trials for original learning}) - (\text{Time/Trials for relearning})}{(\text{Time/Trials for original learning})} \times 100 \quad 1$$

- Most sensitive -- Even if information cannot be recalled or recognised, relearning can demonstrate some memory trace

## Context Dependent cues and State Dependent Cues

### Context-dependent cues

- Forgetting occurs in the absence of relevant environmental or contextual variables – such as the place, noise level etc therefore...
- External cues provide information to assist recall

### State-dependent cues

- Forgetting occurs in the absence of relevant psychological or physiological variables – such as mood, level of stress etc therefore...
- Internal cues provide information to assist recall

## Mnemonic devices

- Efficient methods to improve encoding and recall by using rehearsal, forming images or forming associations, which enhance recall and decrease forgetting
- Not inherently connected to the material that has to be learned but impose meaning and structure on material

- Typically involve adding something to the material to create meaningful associations between what is to be learned and what is already stored in LTM

#### Acronyms

Acronyms are pronounceable words that are created using the first letters of the words to be remembered. An example of an acronym is NASA whereas VCE is *not* an acronym – it is simply an abbreviation.

#### Acrostics

Acrostics are poems where the first letter of each line spells a word

#### Peg-word method

**Pegwords** can be used when numbered or ordered information needs to be remembered. Pegwords are rhyming words for numbers and include the following:

One is a **bun**  
two is a **shoe**  
three is **tree**  
four is **door**  
five is **hive**

six is **sticks**  
seven is **heaven**  
eight is **gate**  
nine is **vine**  
ten is **hen**

Pegwords are substituted for the number to be remembered and associated with the other information.

#### Narrative chaining

- Encoding technique in which the items to be remembered are incorporated into a meaningful story which is then related in order to remember them

#### Method of loci

- Encoding technique that creates visual associations between memorised places and items to be remembered
- Memorise a visual sequence of locations (in your house); Imagine each item in a location in sequence

For example – if you needed to remember a list of items in correct order (ball, milk, book, hat and table) ... 1. Picture your journey to school from home. 2. Choose 5 landmarks that you pass – in order. 3. Visualise each item to be remembered with each landmark. 4. Recall the journey to school and use these visual cues to help recall the 5 items in order.

### ACTIVITY:

As stated above: visualise your journey from home to school.

List 5 landmarks you pass in order, then associate each item on the right with each landmark and recall your journey to school visualising using these *locations* (loci) to enhance your recall.

1. \_\_\_\_\_ **BALL**
2. \_\_\_\_\_ **MILK**
3. \_\_\_\_\_ **BOOK**
4. \_\_\_\_\_ **HAT**
5. \_\_\_\_\_ **TABLE**

### Reconstructive Memory – Eyewitness testimony

Psychologist Elizabeth Loftus has been particularly concerned with how subsequent information can affect an eyewitness's account of an event.

Her main focus has been on the influence of (mis)leading information in terms of both visual imagery and wording of questions in relation to eyewitness testimony.

Loftus' findings seem to indicate that memory for an event that has been witnessed is highly flexible. If someone is exposed to new information during the interval between witnessing the event and recalling it, this new information may have marked effects on what they recall. The original memory can be modified, changed or supplemented. After viewing the film footage of a car accident she asked participants to complete a survey which included variations of the question: "how fast were the cars going when they *contacted*?" with the term *contacted* replaced with other verbs including *smashed* or *hit*. The findings included a higher estimation of speed when the term *smashed* was used in the sentence.

- research methods and ethical principles associated with the study of memory, as outlined in the introduction to the unit.

Notes for this key knowledge have been combined to include relevant research methods for Outcome One: Mind brain and Body as the key constructs are the same. Examples vary using applications to both "Mind, Body and Brain" and Memory.



- experimental research: construction of research hypotheses; identification of operational independent and dependent variables; identification of extraneous and potential confounding variables including individual participant differences, order effects, experimenter effect, placebo effects; ways of minimising confounding and extraneous variables including type of experiment, counterbalancing, single and double blind procedures, placebos; evaluation of different types of experimental research designs including independent-groups, matched-participants, repeated-measures; reporting conventions

### Hypothesis

A falsifiable proposition concerning the possible relationship between two or more variables.

The form of a hypothesis is the predicted outcome of an experiment, how the manipulation of the IV will affect the DV

### Operational definition

Definition of variable in exact terms

These terms are the steps taken in manipulation or measurement of the variable

### Operational Hypothesis

Contains operational definitions of the variables relevant to the experiment as well as information concerning the participants

Therefore...

An Operational Hypothesis is...

A prediction about the relationship of two or more variables, which states the details of the variables and provides details of the target population.

**When asked to write an operational hypothesis. You must do 3 things:**

Identify the population (in **bold** in the example below)

Use operational terms of the variables (IV and DV) (underlined in the example below)

Identify the expected relationship between the variables (eg. which will be higher) (*italics* in the example below)

Eg/ VCE Psychology students who use narrative chaining to memorise a list of 20 words will recall *significantly more* words ( $p < .05$ ) than students using maintenance rehearsal.

## ACTIVITY

Use the advice above to write an operational hypothesis for the following:

A psychologist is interested in investigating whether P plate drivers have better recall of a simple map, learned whilst participants are inside a car, if the context of recall is inside a car or in a classroom.

Population: \_\_\_\_\_

IV: \_\_\_\_\_

DV: \_\_\_\_\_

Prediction – the expected relationship (which is expected to be higher?)

\_\_\_\_\_

Use the brief notes you've written to construct a clear yet operationalised hypothesis:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **Independent variable (IV)**

Manipulated by researcher

Consists of two (or more) treatment conditions to which participants are exposed

Assumed to have a direct effect on the DV

### **Dependent variable (DV)**

Measured by researcher

Observed for changes in order to assess the effect of the treatment

Assumed to be directly affected by changes in the IV

### **Extraneous variable**

Any variable that has the potential to influence the DV in an experiment and therefore bias the results

May be associated with the characteristics of the participants, the experimenter or the experimental design

### **Confounding variable**

Any variable that does have an unwanted effect on the DV in an experiment

The results are therefore biased as it cannot be determined whether they are caused by the IV or the confounding variable

### **Placebo effect (problem)**

A positive or therapeutic result due to a participant's expectations of the effect of an inactive substance or dummy treatment

**Single blind procedure (method of control)**

Design in which the participants are unaware of their research group allocation  
Used to avoid contamination of results from biases and preconceptions of the participants

**Experimenter effect (problem)**

Where the expectations or preconceptions of the experimenter bias the results, by either consciously or unconsciously revealing the desired outcome of the experiment, or through unconscious procedural or recording bias

**Double blind procedure (method of control)**

Design in which neither the experimenter nor the participants are aware of the allocation of participants to research group  
Used to avoid contamination of results from biases and preconceptions of the experimenter or participants

Experimental design	Repeated-measures	Independent-groups	Matched-participants
Description	Involves using the <u>same participants</u> in each condition of an experiment	Involves using <u>different participants</u> in each condition of the experiment	Involves using <u>different but similar participants</u> in each condition of an experiment Participants are matched in characteristics that may influence the DV
Example	A group of participants complete a driving simulation with no alcohol then, after ingesting alcohol, complete the same simulation	One group of participants complete a driving simulation with no alcohol and another group of participants complete the same simulation after ingesting alcohol	Participants are matched in driving ability and alcohol tolerance One group of participants complete a driving simulation with no alcohol and the other group of participants complete the same simulation after ingesting alcohol
Advantages	Participant variables are kept constant More economical as fewer participants are required	Order effects do not occur Demand characteristics are less of a problem	Participant variables are kept more constant between conditions Order effects do not occur Demand characteristics are less of a problem
Disadvantages	Order effects may occur due to learning or fatigue Demand characteristics may occur, participants may guess the aim of the study	Participant variables are extraneous Less economical as more participants are required	Participant variables can never be matched in every respect Matching participants is time consuming Less economical as more participants are required

Adapted from Hill, G. (1998) *Advanced Psychology Through Diagrams*. Oxford: Oxford University Press.

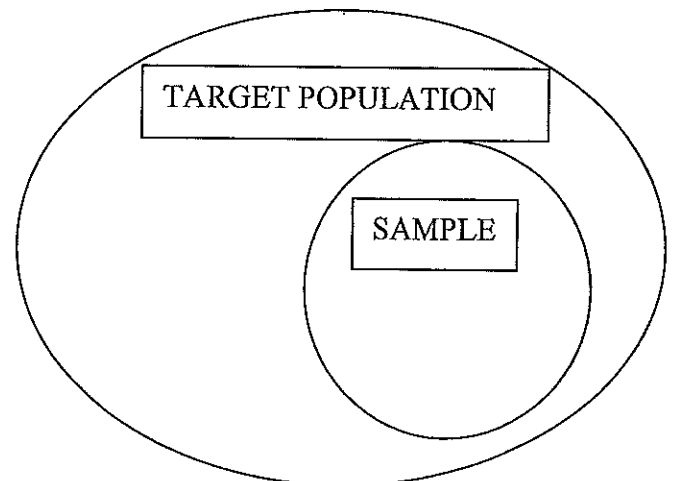
## What is COUNTERBALANCING?

In repeated measures designs, confounding variables can occur because all participants undergo BOTH the control and experimental conditions. For example, participants might become tired or bored, or they may improve simply because they have already had 'practice'. Counterbalancing 'cancels out' this effect.

**Counterbalancing** involves allocating participants to groups and presenting the IV in a different order. All participants still undergo each condition of the IV – but in a different order.

- sampling procedures in selection and allocation of participants: random sampling; stratified sampling; random-stratified sampling; random allocation of participants to groups; control and experimental groups

**Participant selection** is how you choose your sample of participants from the target population. The target population is the group to which you wish to generalise your results. For example, it may be students from a specific school, or from all Victorian schools, or just Year 12 Students in Victoria. Two reputable methods of selecting a sample from the target population are Random sampling and Stratified Sampling.



### **Participant selection**

- Target population \ Sample (representative and of a sufficient size)

### **Random sampling**

- Every member of the target population has an equal chance of being selected
- Example – Put names of every member of the target population in a hat, shuffle and pull out sample without looking
- Strength – Best chance of a unbiased representative sample
- Weakness – The larger the target population the more difficult it is to sample randomly

### **Stratified sampling**

- Members of important subcategories of the target population are selected in the proportion that they occur in the target population
- Example – In a target population of 75% women and 25% men, a sample of 20 should include 15 women and 5 men
- Strength – Deliberate effort is made to identify characteristics of a sample most important for it to be representative of the target population
- Weakness – Time consuming to identify subcategories and calculate their proportions in the target population

### **Participant allocation**

- Assignment of participants to different research groups
- Characteristics of participants which may affect results should be evenly distributed within the different groups
- Random allocation involves each member of the sample having an equal chance of being assigned to each of the research groups

### **Control group**

- Not exposed to the IV (exposed to some unrelated treatment) – Control condition of experiment
- Provides a baseline measure with which to compare the experimental group

### **Experimental group**

- Exposed to the IV – Experimental condition of experiment
- Compared to control group to see whether the IV did affect the DV

• techniques of qualitative and quantitative data collection: case studies; observational studies; selfreports; questionnaires; interviews; brain imaging and recording technologies

### **CASE STUDY**

A detailed study of an individual or group of people. It is usually due to the occurrence of a unique phenomenon or behaviour. In brain research, it is usually a study of a brain-damaged patient. A case study usually employs a range of methods such as observation, interviews, psychological and physiological tests.

As a case study is detailed and often uses a variety of methods, it is valuable in providing an in-depth account of the problem.

As most case studies are of unique phenomena, the results cannot be generalised to the 'normal' population. Often the complexity of the brain damage makes it difficult to come to any valid conclusions about brain function. The time and resources needed to conduct such a detailed study are also a limitation.

### **OBSERVATIONAL STUDIES**

Observational studies can be natural or artificial, participant or non-participant. In any case, an observational study involves careful surveillance (which is usually recorded) of an observable behavior. Observational research consists of systematic observation. The word *systematic* implies a scientific and replicable procedure for collecting data. Data might be collected with a video recording device or by administering a questionnaire or in any other way that can be adequately described for other scientists who wish to repeat the observations. The researcher does not attempt to alter the world during the data collection phase. The data are analyzed, and researchers look for interesting or important patterns.

**Naturalistic observation** is observational research that takes place in a natural or everyday setting such as a school. Usually there is an effort to minimize the observer's impact by carrying out observations secretly or from a hidden vantage point.

**Controlled observation** occurs when observational research is carried out under carefully arranged conditions. Each subject is exposed to the same situation, to see differences between individual reactions.

**Clinical observation** consists of observations made by a skilled clinician interacting with a patient or client. The clinician takes notes on the interaction, usually immediately after the interview or meeting with the client.

Advantages of Observational studies include ecological validity – participants are observed in real and non experimentally manipulated circumstances. This is also an appropriate technique to use when it is ethically and practically impossible to study some behaviours experimentally.

Limitations include problems with reliability, as the observer is subjective and may observe a behaviour differently from others or pay attention to different aspects of the behaviour. There are many ethical issues that arise when subjects are not aware that they are being observed or do not have the ability to consent. If not used in conjunction with any other research methodology, observation does not allow the participant to explain how they feel, what they are thinking etc, as only directly observable events are recorded.

### SELF REPORTS

A self report enables the participant to note and communicate to the researcher how they are feeling, experiences, symptoms etc. It may be in the form of an interview, survey or a journal – such as when studying sleep.

This enables the researcher insight into the internal experiences of the participant that are not directly observable and can have high validity.

However, it is extremely open to demand characteristics, as participants may report what they think the researcher wants to know and omit important information.

### QUESTIONNAIRES

Questionnaires are a type of self report, where the participant answers set questions. The questions may be closed, and the participant selects a response from alternatives or answers a yes/no type question, or open ended allowing for further elaboration. Questionnaires can provide very reliable data, as the same questions are asked of all participants allowing for comparison. It's easy to collect a large quantity of data using this method in a relatively quick and easy manner.

They may however, may not be a valid form of data collection – participants can easily lie or may not understand the question. When email or mail is used, there is often a low response rate.

### INTERVIEWS

Interviews can range from very structured and formal to conversational. They may be one on one or a focus group. The ability of the interviewer or facilitator to establish rapport with the participant and guide the conversation effectively can have an enormous impact on the validity of the results. The interview may be recorded (video or audio) or notes are taken during the interview.

Interviews can have the potential to collect rich qualitative information, such as insights from the participants, details of dreams etc. There may be problems with reliability with less-structured interviews as the direction of the interview may vary between interviewers and interviewees. The data collected from the interviews is usually recorded and transcribed, and then analysed, which is a time consuming process.

### BRAIN RECORDING TECHNIQUES

(See earlier notes re. Brain imaging and recording)



- statistics: measures of central tendency including mean, median and mode; interpretation of p-values and conclusions; reliability including internal consistency; validity including construct and external; evaluation of research in terms of generalising the findings to the population

### **Descriptive statistics**

Summarise the data to show trends and patterns

Measures of central tendency – mean (the average), median (the middle value) and mode (the most frequently occurring value)

### **Inferential statistics**

Decide whether results of research are statistically significant

Determine whether research conclusions can be generalised from a sample to a population

### **Statistical significance**

- A significant result is one where there is a low probability that chance factors were responsible for any observed difference or correlation between the variables investigated

### **P values**

- Expressed as p (probability) values, decimals in the form of  $p < 0.05$ , where 'p' stands for the probability that chance factors were responsible for the results
- The lower the p value, the greater the significance
- Psychological convention holds that a result with  **$p < 0.05$**  is considered to be significant, at this level there is a 5% probability that chance factors were responsible for the results

( $p < .01$  indicates that there is a less than 1% probability that chance factors were responsible for the results.)

### **Conclusion**

Decision about what results obtained from a research study mean

If results are significant the research hypothesis is supported

### **Reliability**

Reliability refers to the consistency of a measure. A test is considered reliable if it gets the same result repeatedly.

Internal reliability or consistency refers to the extent to which a measure is consistent within itself. The internal reliability of self-report measures, such as psychometric tests and questionnaires can be assessed using the split half method. Where the test/questionnaire is split in half and the participant completes both sections. If the results are similar for both halves it is said to be reliable.

### **Validity**

Validity refers to whether a study measures or examines what it claims to measure or examine. Construct validity is a way of assessing validity by investigating if the measure really is measuring the theoretical construct it is suppose to be. External validity refers to whether the findings of a study really can be generalised beyond the present study. Population validity is a type of external validity - which refers to the

extent to which the findings can be generalised to other **populations** of people. Ecological validity refers to the extent to which the findings can be generalised beyond the present **situation**.

### **Generalisation**

Judgment where the findings of a study are applied to the population from which the sample was drawn

Results can only be generalized to the population if the results were significant **and** the sample was representative of the population (such as a random or stratified sample).

- ethical principles and professional conduct: the role of the experimenter; protection and security of participants' rights; confidentiality; voluntary participation; withdrawal rights; informed consent procedures; use of deception in research; debriefing; use of animals in research; role of ethics committees.

These ethical principles are extremely important for maintaining the rights of participants, when conducting brain research. Many research studies are interested in investigating abnormal brain functions and brain damaged patients. The rights for participants to participate voluntarily and to be informed about (and to understand) the nature of the research, must be carefully considered for patients such as these. Other ethical issues, such as confidentiality, arise when wishing to publish the results of patients/participants from brain research. Especially detailed case studies, where the identity of the patient/participant might be more easily identifiable from the depth of data collected.

### **Role of experimenter – Professional conduct**

- Research must be conducted in such a manner that the welfare of participants is not compromised
- Comply with appropriate ethical procedures when initiating and undertaking research
- In all scientific research with human participants, there is a need to balance the welfare of those who ultimately may benefit from the findings of the investigation against any discomfort or risks to participants

### **Confidentiality**

- Test results or other confidential data obtained in a research study must not be disclosed in situations or circumstances which might lead to the identification of the participants unless their informed written consent has been obtained
- Provisions must be made for maintaining confidentiality in the access, storage and disposal of research data. This is also in relation to the storage and disposal of data such as CT scans being published in Psychology textbooks.

### **Informed consent procedures – Voluntary participation and withdrawal rights**

- Researchers must endeavour to ensure that participants' consent to be involved in research is voluntary
- Wherever possible, participants must be appropriately informed of the nature and purpose of the investigation
- Participants must be informed that they are free to participate or to decline to participate or to withdraw from the research
- Informed consent must be appropriately documented

- For participants legally incapable of giving informed consent, appropriate consent must be gained from those legally responsible for the participants' welfare
- Excessive financial or other inappropriate inducements must not be offered to obtain research participants

#### Deception in research

- When it is necessary for scientific reasons to conduct a study without fully informing participants of its true purpose prior to the commencement of the study, it must be ensured that participants do not suffer distress from the research procedure
- Participants must be informed of the purpose of the investigation at the conclusion of the research
- The quality of the relationship between researchers and participants must be maintained and any mistaken attitudes or beliefs that participants may have about the research must be corrected

#### Debriefing

- The subsequent effects of research participation must be anticipated and information provided on services available for participants to alleviate any unnecessary distress that follows from their participation
- Researchers must not engage in other professional relationships with research participants in relation to resolving any such distress
- Opportunity must be provided for participants to obtain appropriate information about the nature, results and conclusion of the research

\* Adapted from the Australian Psychological Society Code of Ethics

Website: [www.aps.psychsociety.com.au](http://www.aps.psychsociety.com.au)

#### Use of Animals in Research

- The following are some of the APA guidelines regarding animals. There are further guidelines regarding housing of animals etc.
- The scientific purpose of the research should be of sufficient potential significance to justify the use of animals. Psychologists should act on the assumption that procedures that would produce pain in humans will also do so in other animals.
- The species chosen for study should be best suited to answer the question(s) posed. The psychologist should always consider the possibility of using other species, nonanimal alternatives, or procedures that minimize the number of animals in research, and should be familiar with the appropriate literature.
- Research on animals may not be conducted until the protocol has been reviewed by an appropriate animal care committee
- The psychologist should monitor the research and the animals' welfare throughout the course of an investigation to ensure continued justification for the research.

#### Ethics Committees

An independent ethics committee (IEC) or ethical review board (ERB), is a committee that has been formally designated to approve, monitor, and review biomedical and behavioural research involving humans with the aim to protect the rights and welfare of the research subjects.



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